the OIL AND GAS JOURNAL

EXPLORATION NUMBER
16-Page Map Section . . . Pages 103-118

News Desk

News Desk

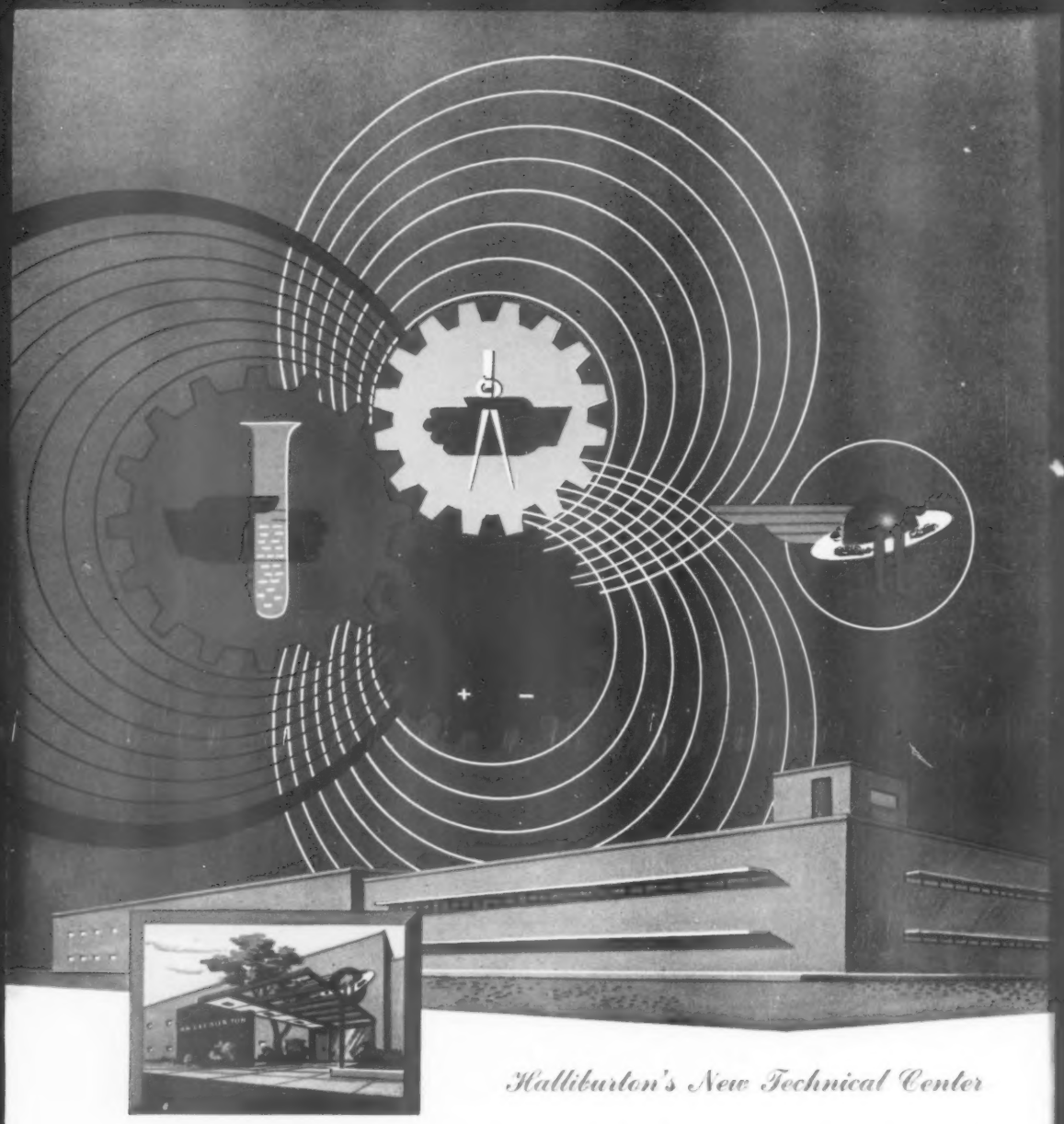
RESEARCH THAT NEVER ENDS

We've never made a rock bit that completely satisfied us . . . and we never will, although we have made millions of bits. One improvement has invariably led to others, opening new frontiers for research and progress. As a result, record breaking bits of not too many years ago have become today's museum pieces.

Through the years Hughes Tool Company's expenditures in research and engineering to improve the performance of its bits and advance rotary drilling have run into millions of dollars. Currently, these expenditures are at a rate of more than $1,500,000 per year.

This continuing research enables Hughes to keep pace with the constantly changing needs of a fast moving drilling industry. Progress dictates that we can never be satisfied with any improvement of the moment.

PRICE 50 CENTS TABLE OF CONTENTS ON PAGE 1 **MARCH 30, 1953**



Halliburton's New Technical Center

SCIENCES
INTEGRATED FOR GREATER RESEARCH

Tomorrow's in the making on a major scale at Halliburton. For there on the horizon a new Technical Center rises. This big, modern building will dovetail all the sciences dedicated to developing new tools and technology. Now more closely integrated for even greater research are the highest skills of Engineering, Chemistry, and Electronics. Pure scientific projects contribute academic knowledge for practical application to immediate and future problems. Every new discovery opens new vistas for experimentation and whets the urge to find still better ways of doing things. The new Technical Center culminates a quarter century of energetic research. But Halliburton is nowhere near satisfied with its progress – you can expect Halliburton to continue enriching the industry with important production improvement techniques.

HALLIBURTON OIL WELL CEMENTING CO., DUNCAN, OKLAHOMA

PERPETUAL PROGRESS IN PRODUCTION IMPROVEMENT TECHNIQUES

the OIL AND GAS JOURNAL

MARCH 30, 1953 VOL. 51 NO. 47

OIL IN THE NEWS...

New Drilling Techniques Employed in Deep Weeks Island Field 56
Spraberry Ordered Shut In Until All Gas Can Be Conserved 57
Lower Costs and Prices Needed to Fight Imports, Dunlop Declares 58
First Permanent Quarters of A.A.P.G. Dedicated in Tulsa 60
Dr. Frederic Lahee Presented Sidney Powers Memorial Medal 61
A.C.S. Told Radioactive Tracers Speed Lab Processing Research 62
Vickers Dedicates New Derrick-Type T.C.C. Unit at Potwin, Kans. 62
Chemical Inhibitors Said to Be Remedy for Sweet-Well Corrosion 63
Dow Saving $5 for Each $1 Spent on Cathodic Units, N.A.C.E. Told 64
Critical Factors Often Missed in Designing Cathode Systems 64
Fuel-Oil Outlook Good for Next 3 Years, Economists Tell W.P.R.A. 67
There Is No Great Excess of Refining Capacity, Tollett Claims 68
Du Pont Paper Reveals New Information on Engine Deposits 68
Proposed New Materials Plan to Supersede CMP July 1 Outlined 75
Free World Production Drops 66,500 Bbl. to 11,642,200 Bbl. Daily 76
American Independent Wildcat in Neutral Zone Finds Thick Sand 77
Completions Drop But Total Still Ahead of Last Year 218
Midwinter Slump Slows Drilling Activity 220

NEWS FEATURES...

They Say 42
Calendar of Events 46
Journally Speaking 51
Editorial 53
This Week 55
Watching Washington 75
International News 76
Personals 80
Deaths in the Industry 82
Books 143-168
Equipment Men in News 201
Pipe-Line News 204
Refining News 208
Drilling Contractors 210
Natural-Gas News 214
Natural-Gasoline News 214
Areal Field Reports 221
Industry Statistics 239
Classified Advertising 243
Advertisers' Index 247

SPECIAL EXPLORATION SECTION...

U. S. POOL MAPS, Principal Oil and Gas Areas 103-118
SYMPOSIUM ON VELOCITY SURVEYS 119-137
Why the Symposium Was Held 119
By L. Y. Faust
How to Make Use of Survey Data 120
By B. G. Swan
How to Improve Survey Accuracy 124
By Robert C. Kendall
How to Improve Quality of First Breaks 126
By Neil R. Sparks
Time-Measurement Problems 129
By J. E. Owen
How Much Control Is Needed? 133
By Francis H. Cady
Value of Velocity Surveys 135
By Paul L. Lyons
Wildcat Score: 12,424 Holes—2,334 Wells 138
By Frederic H. Lahee
Geophysical Activity Soars to New High 144
By E. A. Eckhardt
Eocene Search in Southern Joaquin Valley 148
By D. H. Stormont
Seismic Problems in Denver-Julesburg Basin 152
By Joseph A. Kornfeld
The Demand for Petroleum Geologists 165
By Morgan J. Davis
Our Human Assets in Geophysics 169
By Curtis H. Johnson
An Evaluation of Foraminifera 171
By C. C. Church
Selected A.A.P.G., S.E.G., and S.E.P.M. Digests 174

TECHNOLOGY AND OPERATION...

Building Refinery Process Units—2 . . . Scheduling 180
Engineering Reference Section 187-198
There's No Oil in Dimwitt County 217

In Brief...

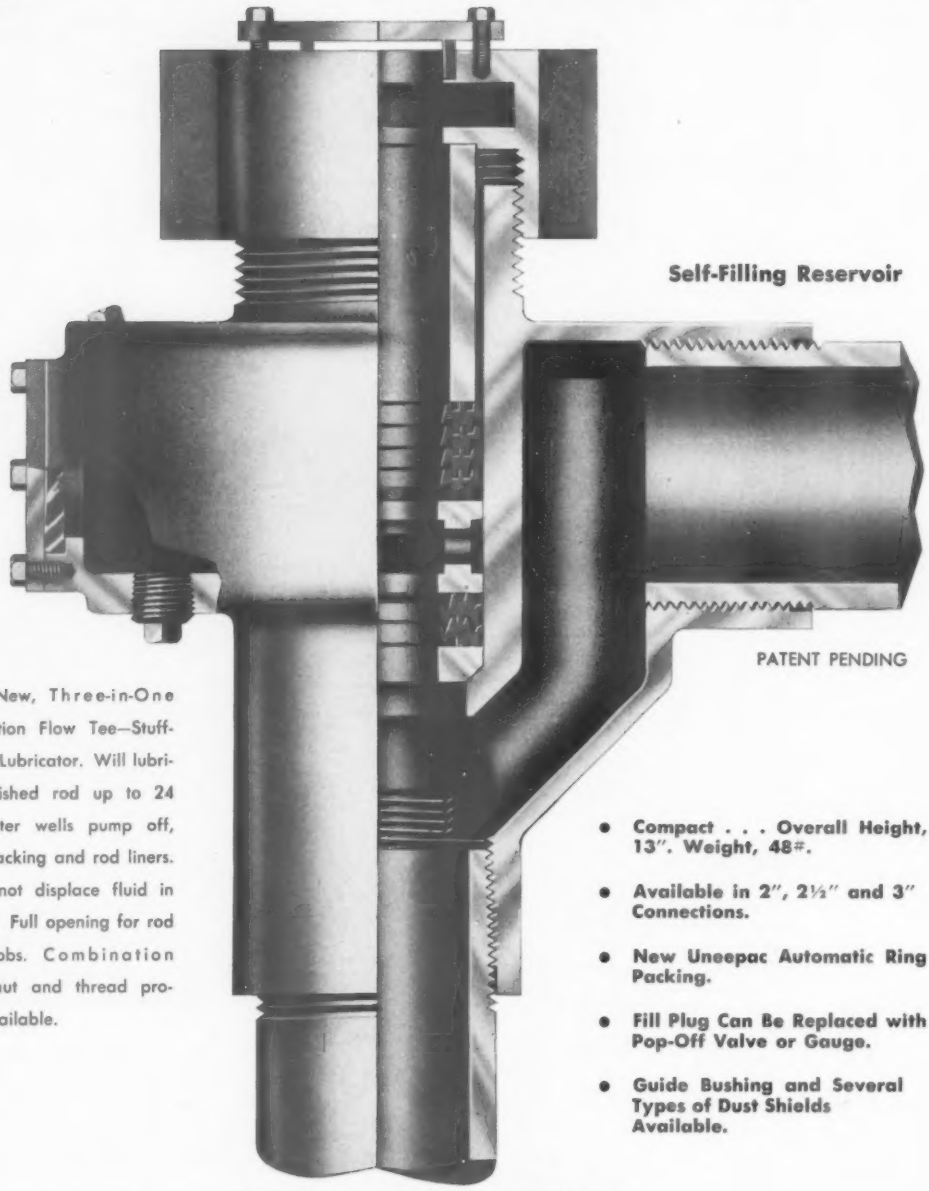
VELOCITY SURVEYS . . . One of the outstanding developments in seismic prospecting during the past 2 years is the tremendous increase in the number of velocity surveys being made available to the industry. These surveys can be made more accurate and more valuable if these four points are kept in mind: (1) the assumption of a constant velocity is erroneous; (2) a reasonably accurate representation is possible with a small amount of velocity control; (3) large errors of prediction may eventually occur due either to miscorrelations or to lack of adequate velocity control; (4) high-precision surveys in sufficient quantity are necessary to resolve the cause of error.

U. S. POOL MAPS . . . Principal oil and gas areas of the United States are shown in this 16-page section. Included are: (1) California, (2) Intermontane Basins, (3) Northern Wyoming, (4) Williston Basin, (5) Kansas, (6) Julesburg Basin, (7) Hugoton Area, (8) Oklahoma, (9) North and East Texas, (10) Permian Basin, (11) West Gulf Coast, (12) South Texas, (13) East Gulf Coast, (14) Miss.-La.-Ark., (15) Tristate area, and (16) Michigan.

1952 EXPLORATORY DRILLING resulted in 2,334 producers, representing 11,878,531 ft. of drilling; and 10,090 dry holes, representing 43,730,875 ft. of drilling. Majors drilled 1,286 new-field wildcats, 217 being producers. Minors and independents drilled 4,912 new-field tests, with 487 being completed as producers.

SOARING GEOPHYSICAL ACTIVITY. Whatever the economic climate may be in the next year or two, increased exploration will be necessary because of the inevitably increasing demand for petroleum products. Big problem faced by operators is manpower.

POLISHED ROD LUBRICATOR AND STUFFING BOX TYPE "B"



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The All-New, Three-in-One Combination Flow Tee—Stuffing Box—Lubricator. Will lubricate polished rod up to 24 hours after wells pump off, saving packing and rod liners. Gas cannot displace fluid in reservoir. Full opening for rod pulling jobs. Combination packer nut and thread protector available.

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MUSKOGEE, OKLAHOMA

You get MORE CAPACITY with a FANMIX BURNER

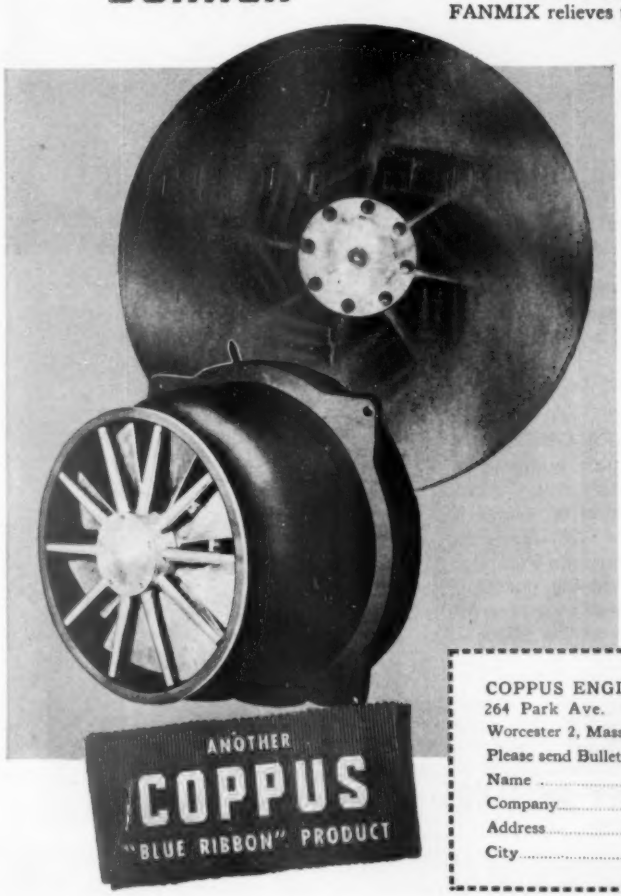
Increase Boiler Ratings On Present Or Planned Equipment

In all types of Coppus-Dennis FANMIX Burners — straight gas or combination gas-oil — we utilize the energy of the fuel under pressure to drive the burner fan and deliver air in the proper proportion to the fuel flow. This exclusive "pinwheel action" *mechanically* mixes fuel and air in exactly the right proportions for truly radiant, non-luminous heat.

The result is uniform temperature everywhere in the combustion chamber — no drifting "hot spots" — and complete combustion under all conditions. That's why you can release more heat into your present furnace — why in new installations you get more heat into smaller furnace space.

FANMIX Saves On Both Old and New Installations

FANMIX can easily be operated with your present furnace and stack, requiring only minor changes in other equipment. Or if you're planning on new boilers, remember that FANMIX relieves the furnace from the burden of mixing, creates its own forced draft and takes smaller pipe sizes. Which means you can plan on reduced combustion space, less stack, no forced draft equipment and lower installation costs all around.



Get the Whole Story

Coppus engineers FANMIX Burners to meet individual requirements, providing complete control over heat pattern and combustion . . . Learn more about how "pinwheel action" can step up *your* boiler performance to peak efficiency and economy — as it is doing throughout industry. Send for Bulletin 410-6. Coppus Engineering Corp., Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG, and MINING CATALOGS.

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"We hold these truths to be self-evident,—that all men are created equal; that they are endowed by their Creator with certain inalienable rights; that among these are life, liberty, and the pursuit of happiness."

—Thomas Jefferson (1743-1826)

AMERICANS ARE GREAT for *any* job where unit pumping is practical, because American Manufacturing Co. can furnish exactly the right combination of structure and reducer to pump any particular well most economically. The complete line of American Pumping Units from the husky little T-5 to the big, powerful T-27 are described in Catalog 151. Ask your favorite supply store or write the nearest American office.

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MANUFACTURING COMPANY OF TEXAS

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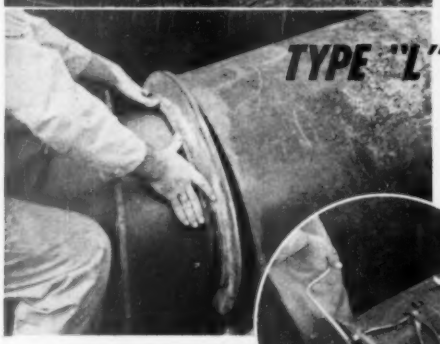
Branch Offices: HOUSTON—KILGORE—ODESSA—TULSA

A tested and proven design for efficient pipeline protection. . . . More than 18,000 crossings equipped since 1950. . . .

Williamson

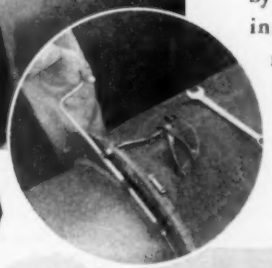
CONCENTRIC-SUPPORT INSULATORS

Provide low-cost, dependable protection for right-of-way crossings . . . Simple to install with a common wrench . . . Impervious to pipe coatings . . . Support blocks center pipe in casing, spacer blocks provide clearance through casing . . Available for all combinations of pipe and casing diameters.



TYPE "L" WmSEAL CASING BUSHINGS

Provide a water-tight seal even under the worst conditions of out-of-round casing . . . Unaffected by dirt, moisture or backfill during or after installation (no dope, adhesive or shield required) . . . Electrical insulation of pipe from casing provides economical cathodic protection.



Easily installed with common hand tools.

Write for Bulletin 249-A

T. D. Williamson, Inc.

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CLEANS PIPE LINES

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TULSA 9, OKLAHOMA

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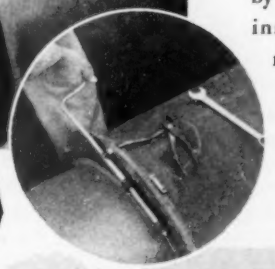

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MIDWEST

The Only Change is in the Name

MIDWEST PIPING & SUPPLY CO., INC.
has Changed its Name to

Midwest Piping Company, Inc.

6283

Because the word "Supply" is no longer accurately descriptive of the major business operations of this company, the stockholders have voted to drop it from the corporate name.

There has been no change in management, ownership or business at Midwest . . . and none is contemplated. Only the name has been changed. Midwest continues all its activities in the fabrication and installation of piping, and in the manufacture of welding fittings.

MIDWEST PIPING COMPANY, INC.

Executive Offices: 1450 South Second St., St. Louis 4, Mo.
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MANUFACTURERS OF WELDING FITTINGS FOR MORE THAN 20 YEARS

PICTURE OF A PLANT—

Equipped for ANY Pipe Threading Operation!

An installation of eight LANDIS Pipe Threading Machines is shown at Jarcho Brothers' plant in Long Island City. These machines, ranging from 2" to 12" in size, thread, ream, bevel, and cut off pipe varying from ½" to 12" in diameter.

LANDIS Pipe Machines are built for heavy-duty service in continuous production. Quality threads and close concentricity is guaranteed by the sleight floating action of the die head in the T-slot of the crossrail, and by the adjustable grip feature which assures correct alignment of the work in the chucks.

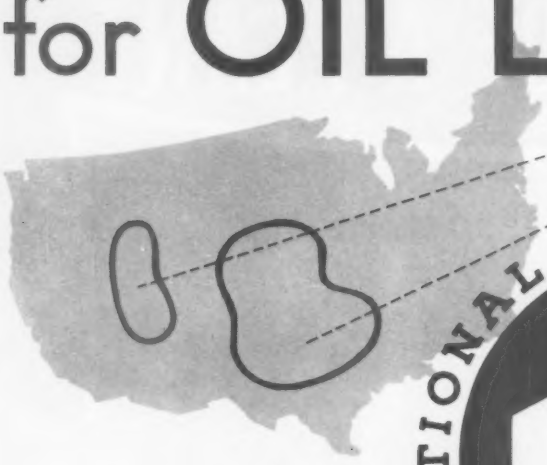
Tool inventories are relatively small since the LANDIS Chasers used will thread all diameters within the range of the die head having the same form, pitch, and taper. These chasers also reduce tool replacement cost for they can be reground and used for most of their length, and can be replaced individually as needed.

LANDIS

THE LANDIS *Machine* CO. 50TH ANNIVERSARY '00 WAYNESBORO PENNSYLVANIA

Represented in the Domestic Oil Fields by: Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; C. J. Harter Machinery, Houston, Texas; Frederic-Baker Co., New Orleans, La.; Moore Machinery Co., Los Angeles and San Francisco, Calif.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.

for OIL LOANS



in the

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and

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Oil operators in the Mid-Continent and Rocky Mountain areas can count on NBT for prompt and friendly consideration of their customers' oil finance needs. NBT's oil loan service is sound, practical and of mutual benefit. NBT's officers are experienced in dealing with oil men—they understand and appreciate the problems and financial requirements for exploration—drilling—production—refining and pipe line operations. NBT is giving helpful counsel and financial assistance to oil companies and independent operators. Bring your problems to "The Oil Bank of America."

The Oil Bank of America

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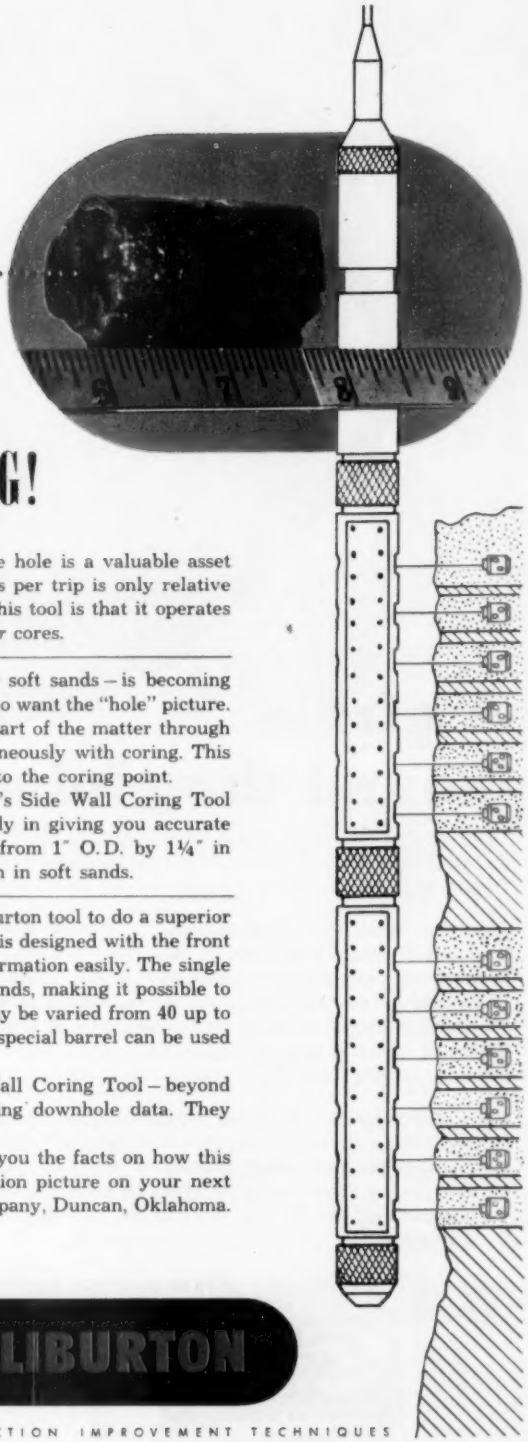
MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

NEW 30-SHOT TOOL GIVES 80% RECOVERY AND LARGER CORES



HALLIBURTON'S SIDE WALL CORING!

The ability to fire 30 shots during each trip into the hole is a valuable asset of Halliburton's Side Wall Coring Tool. But 30 shots per trip is only relative to results attained. The really important feature of this tool is that it operates effectively, yielding 80% average recovery and *larger* cores.

This fact – greater recovery in hard formation or soft sands – is becoming increasingly important to cost-conscious operators who want the "hole" picture.

Halliburton's Side Wall Coring Tool gets to the heart of the matter through use of a potential logging ring that operates simultaneously with coring. This ring insures proper positioning of the tool relative to the coring point.

Undistorted cores are important, too. Halliburton's Side Wall Coring Tool provides clean, uncontaminated cores that aid greatly in giving you accurate data on downhole formations. Core volumes range from 1" O.D. by 1¼" in length in hard formations, to 1⅛" O.D. by 2" length in soft sands.

There are other advantages that enable this Halliburton tool to do a superior job for you. The barrel of the Side Wall Coring Tool is designed with the front larger than the back so it may be pulled out of the formation easily. The single retrieving cable has a breaking strength of 2,000 pounds, making it possible to retrieve deeply buried barrels. And powder loads may be varied from 40 up to 110 grains to allow coring of hard formation, while a special barrel can be used in the same gun to core soft formations.

These exclusive features of Halliburton's Side Wall Coring Tool – beyond its 30-shot ability – mean greater accuracy in gaining downhole data. They mean less rigtime lost; lower costs.

Your nearby Halliburton representative can give you the facts on how this important tool can provide you with the big formation picture on your next job. Or contact Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

HALLIBURTON

YEARS AHEAD IN PRODUCTION IMPROVEMENT TECHNIQUES

A girdle 'round the globe

The total length of G-R Finned Tubing that has been furnished for heaters, coolers, condensers and heat exchangers would circle the world.

More than 70,000 Twin G-Fin Sections . . . just one of the many types of G-R Finned Tube Units . . . have been installed, serving the broadest range of applications of any heat transfer apparatus on the market. Many thousands of K-Fin Air and Gas Coolers have been built for stationary plants and shipboard. For more than 30 years, G-R Finned Tubing of various designs has been widely used for heat transfer apparatus ranging from tubular units to open sections.

Thus, each design of G-R Finned Tubing has given complete proof of its effectiveness and also its durability. Investigate the applications of these time-proven heat transfer elements for *your* plant, particularly for handling viscous liquids and gases. Write for bulletin describing their features and uses, and the types of exchangers for which they can be furnished.

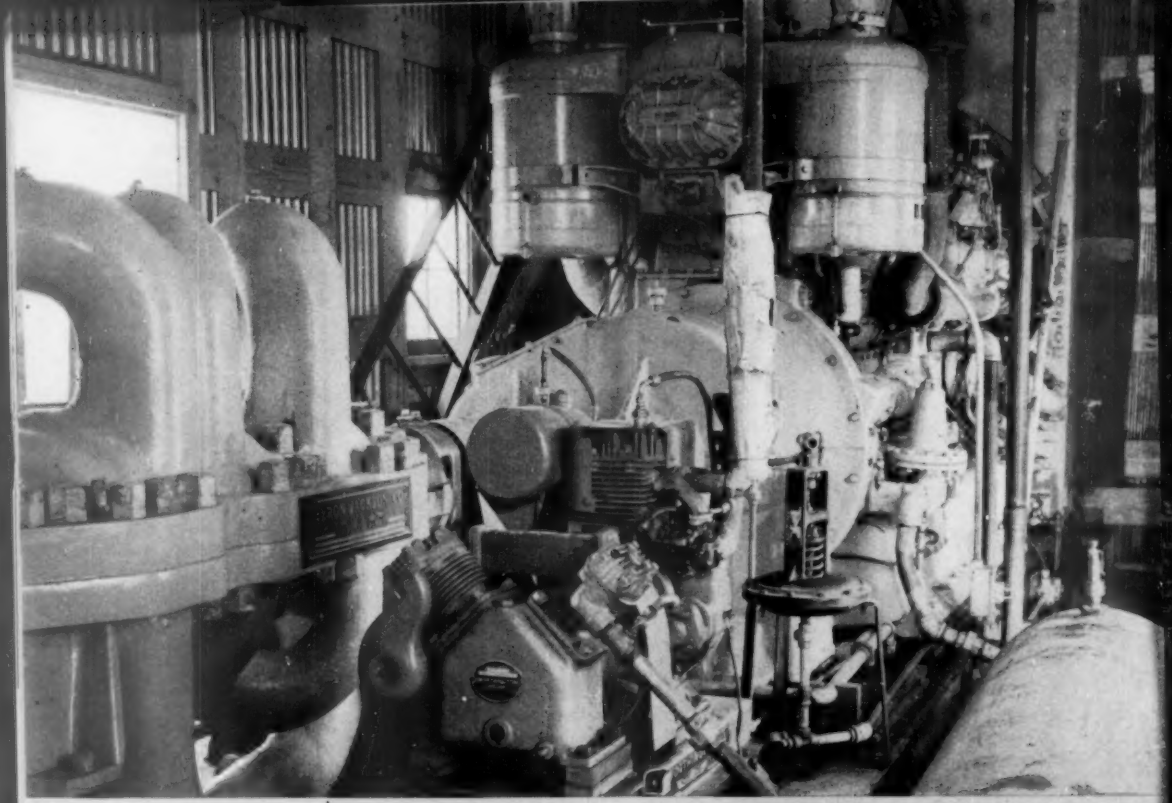
G-R G-Fin Longitudinally-finned Tubing . . . specially adapted to transfer of heat to and from liquids of higher viscosity than water.

G-R K-Fin Helically-finned Tubing . . . specially adapted to transfer of heat to and from vapors and gases.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

G-R HEAT TRANSFER APPARATUS *Finned Tubing*

GR 293



BOSS *of a booster station for Standard Oil Company of Indiana*

This Cat* D397 Engine is on its own in a temporary booster station on the Product Pipe Line between Whiting and Indianapolis, Indiana. It drives a six-stage 4 x 6 Byron-Jackson Pump, with an 18,800-bbl. capacity per day. The line, owned by Standard Oil Company of Indiana, carries refined products only.

Dependability is vital in this unattended operation, where working time depends on the need of the product in Indianapolis. Installed with automatic controls, the unit maintains uniform discharge pressures, and/or uniform suction pressures or any selective balance between the two. Like other Caterpillar Diesels, it is proving a sound investment with its reliable, low-cost performance.

Whatever your job, you can't beat these rugged yellow engines for stamina and economy. They're easy to install, simple to operate and require a minimum of attention. They burn low-cost No. 2 furnace oil without fouling. And they're backed by a dealer organization that's on the spot with genuine parts and prompt service, when needed. All these—and other advantages—add up to a headache-free, money-saving investment for you.

Leading manufacturers of oil field equipment can supply Caterpillar Diesels in all their products. Engines and electric sets are available in 12 sizes up to 500 HP and 315 KW. And they're honestly rated—the output they promise is the output they deliver. Ask your Caterpillar Dealer to prove how they can pay off for you!

Caterpillar Tractor Co., Peoria, Illinois.

CATERPILLAR*

*Both Cat and Caterpillar are registered trademarks—®

NAME THE DATE... YOUR DEALER WILL DEMONSTRATE

J&L STEEL

SHOT HOLE CASING

Faster, more convenient, more economical for seismograph crews

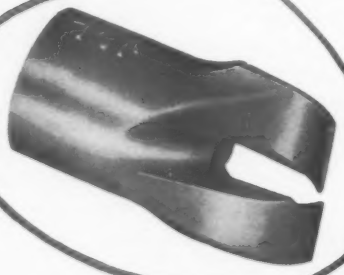
In most formations you can drill with the casing. It has high torsional strength.

It is light, easy to handle. 3" O.D. weighs only 2.037 lbs. per foot. 4" O.D. weighs only 2.732 lbs. per foot. Furnished in uniform 10' to 20' joints.

Rolled threads with 15,000 lbs. pull out strength average.

Integral joint; no independent couplings. Available quickly, anywhere. 'Phone your J&L store.

PESA



This inexpensive, expendable bit has threads to match the casing. Large water course. Fast-cutting fishtails. Drilling and setting in one operation saves time and money where formations are favorable.

JONES & LAUGHLIN STEEL CORPORATION
SUPPLY DIVISION

J&L STEEL

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Series 1900—a 6" to 10"x18" duplex piston type pump for suction service on large capacity gravity lines and for low-pressure, large-volume transfer service.

They Fit The Job Precisely

It is never necessary to fit square pegs into round holes when you use Gaso Pumps. For every need in their field, there is a size and model that fits the conditions as if tailor-made to the job. Do you have a copy of our latest catalog?

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EXPORT OFFICE: 149 BROADWAY, NEW YORK

Shreveport: W. L. SOMNER CO., 419 Lake Street • Los Angeles: 2529 Chambers St., Vernon • Western Canada: Lufkin Machine Co., Ltd., Edmonton, Alberta
Houston: PEDDLERS, Inc., 4401 Navigation Street

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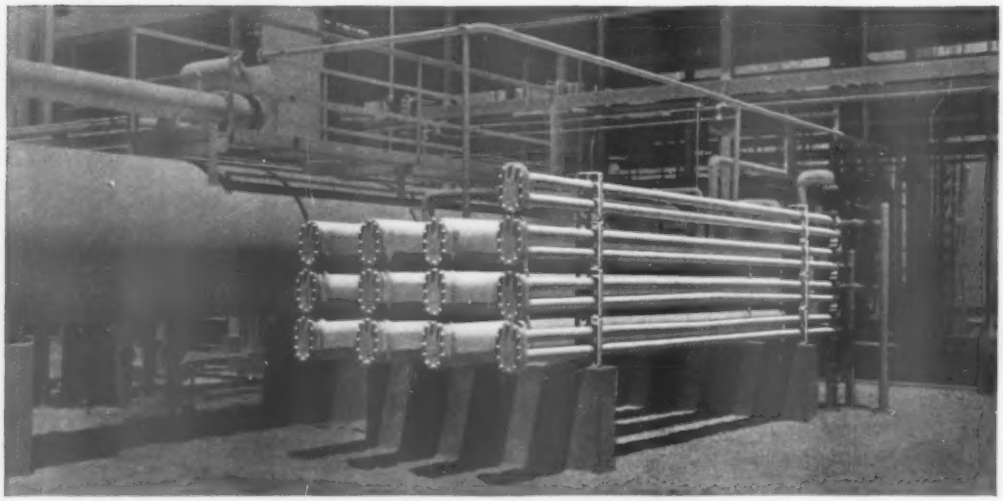
for every oil industry need

Assure Flexibility

in your plant with



BROWN FINTUBE *Sectional* HEAT EXCHANGERS

● Production schedules — and processing techniques change. Consequently, you can never know positively, what your fluid heating and cooling needs will be next year — or even next week. Because Brown Fintube Heat Exchangers consist of *standard sections* connected in proper series-parallel arrangement, they can be rearranged easily and quickly to meet changing conditions.

You simply add, or remove, a few sections, or change the series-parallel manifolding. The plant can be operating efficiently, on almost any new duty, on short notice,— and with a minimum investment in new equipment. "Bundle" type exchangers are not flexible. For them a change involves the delay and expense of designing — and waiting — for a whole new unit.

Flexibility is only one of Brown Fintube's many advantages. You'll find full details in our Bulletin No. 512. Send for a copy. It will give you ideas.

BROWN FINTUBE CO.
Elyria, Ohio

● Integral One-piece Fintubes; Sectional Heat Exchangers and Coolers; Vertical Heaters for Bulk Storage Tanks; Tank Suction Heaters; Pressure and Suction Line Heaters; Process Tank Heaters; Fired Indirect Heaters and Special Types of Fintube Heaters and Coolers.

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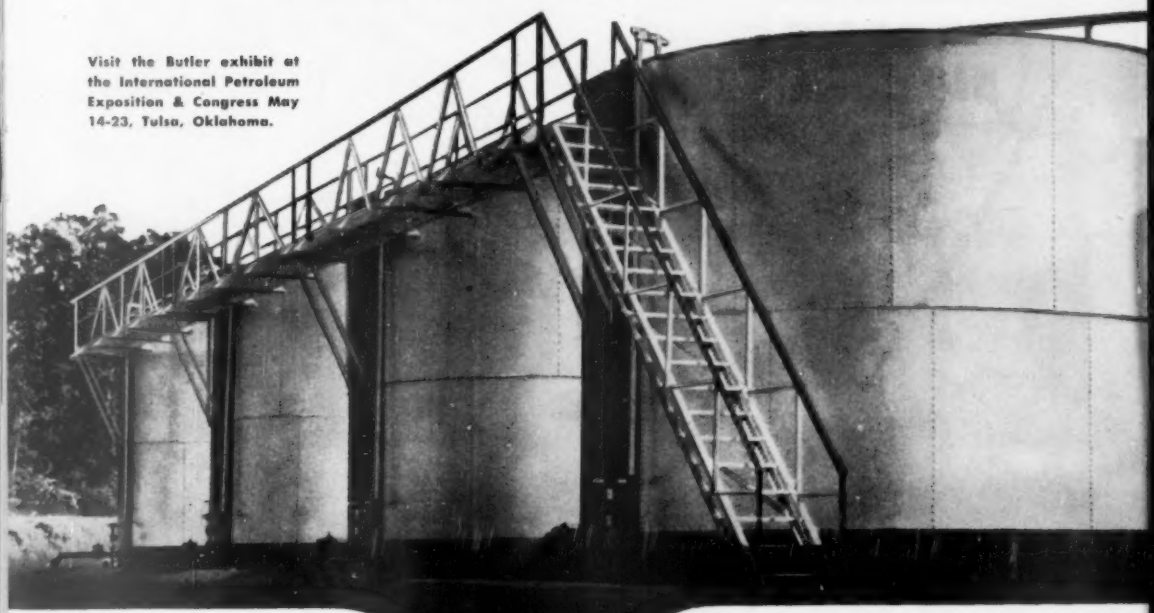
Visit the Butler exhibit at the International Petroleum Exposition & Congress May 14-23, Tulsa, Oklahoma.



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Rigidly tested Butler Tanks meet all API specifications. You get a safe, oil-tight installation because precision parts of Butler Tanks fit exactly, bolt tightly together. AND your Butler installation can be easily disassembled and re-erected. In every way, Butler Tanks are by far your best long-term investment. Available in 100 to 10,000 barrel capacities—two-coat aluminum-finished or galvanized by the hot dip process—with steel or aluminum decks.

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Before you buy:

COMPARE ALL MAKES!

Marr Equipment Corp., Boston, reports HC-90, in addition to precision maneuverability, is outstanding in its stability, an important factor in pipeline welding operations.

Feature for feature . . . dollar for dollar . . . job for job . . . you can't buy better

Independent Rapid Boom Hoist provides fast, safe, power-controlled booming up and down and exact placement of all kinds of loads. You can boom, hoist, swing . . . independently or simultaneously.

WHAT makes a Link-Belt Speeder so ideal for pipeline work? Well, take the 25-ton capacity truck-mounted HC-90 for example: It delivers 92 net hp at full load speed with diesel engine, has work speeding Independent Boom Hoist, not to mention outstanding stability. It's fast, maneuverable, yet takes rugged pipelining with a minimum of maintenance or service.

Like the HC-90, every Link-Belt Speeder combines quality construction throughout with advanced design to speed your work, give you more per equipment dollar.

If you'd like details about this complete line of crawler, truck and wheel-mounted shovel-cranes ask your distributor or write for Catalog 2373.

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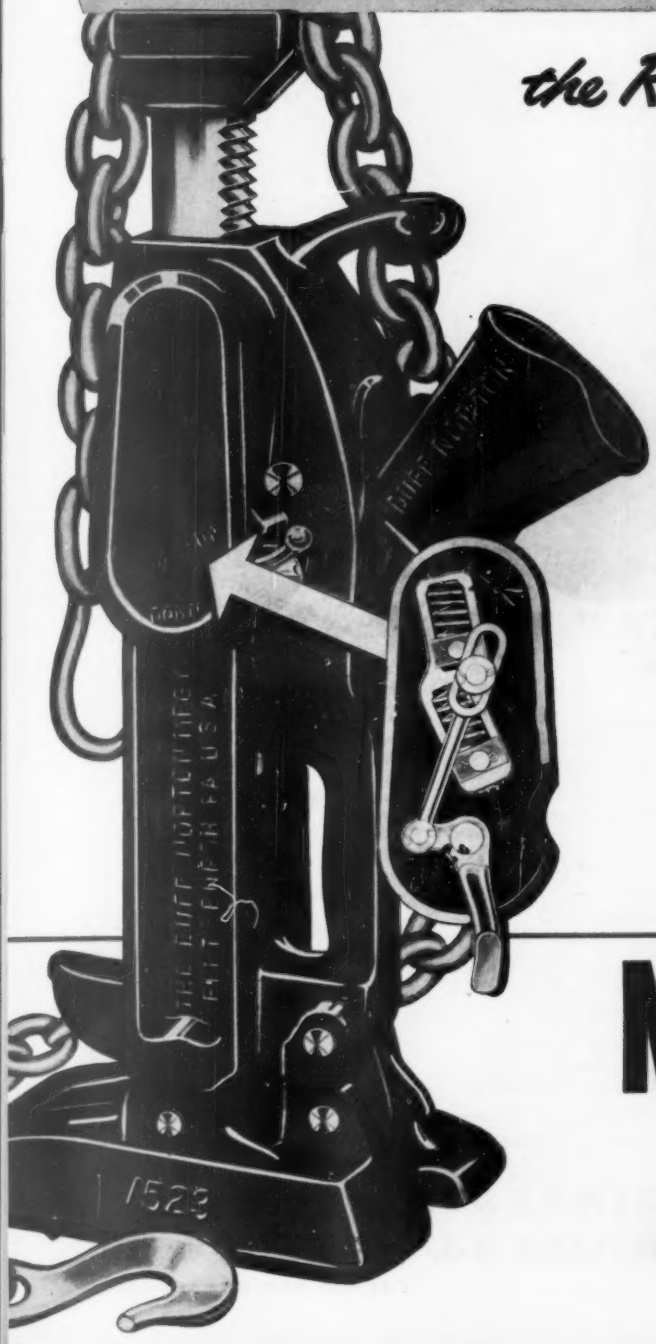
Why this special oil field jack will give longer trouble-free service



the Roustabout "1523"

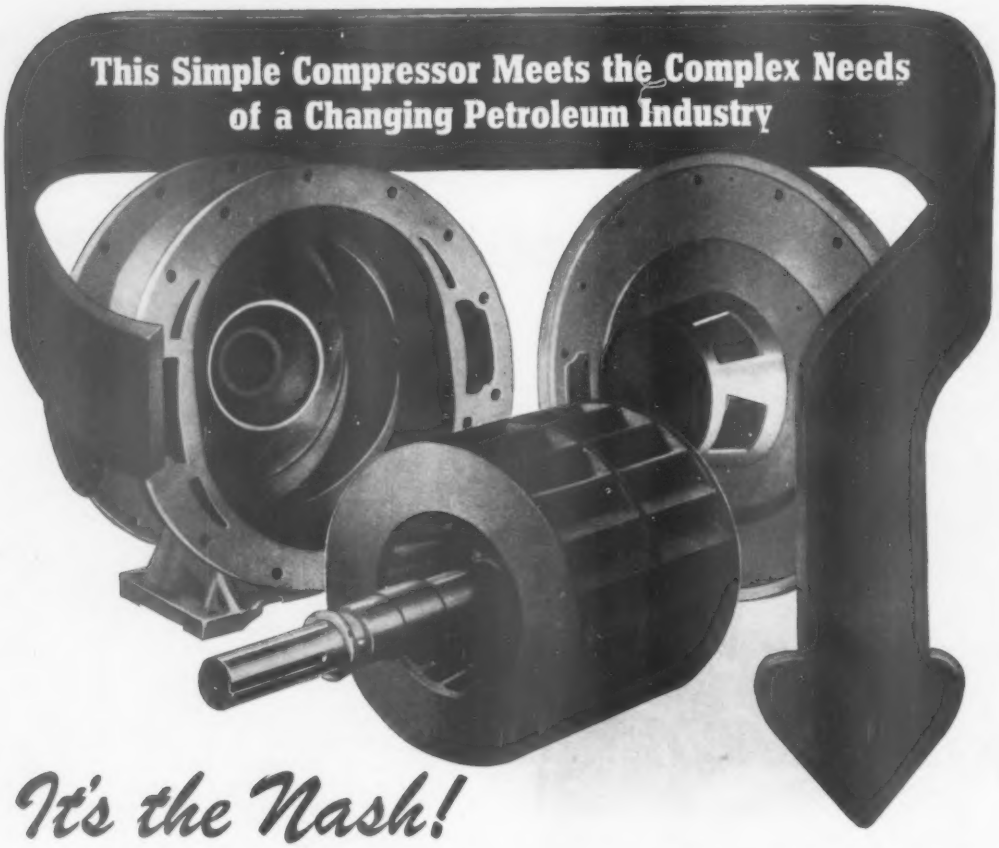
When Duff-Norton engineers set out to design safer, longer-lasting jacks for men who work in the oil fields, they discovered one startling fact—about 90% of jack maintenance was in replacing worn springs in the mechanism that controls the jack's raising or lowering action. Result? The Duff-Norton Roustabout "1523" oil field jack is equipped with a patented*, adjustable spring mechanism which assures positive engagement of rack teeth. The spring's tension can be easily adjusted with a screw driver without removing any part of the jack. Should the spring eventually lose its resiliency, there's no need to send the jack to a repair shop. A new, complete spring mechanism assembly can be quickly installed by anyone in a matter of minutes right in the field, making the jack as good as new!

Complete with detachable steel chain, this versatile jack can be operated at any angle at its full 15-ton capacity. Ask your supply store salesman for the Duff-Norton Roustabout "1523." He has it in stock or can get it for you quickly. For complete specifications on this and other dependable Duff-Norton jacks, write the world's oldest and largest manufacturers of lifting jacks for special Oil Field Jack Bulletin AD19B, The Duff-Norton Manufacturing Co., P. O. Box 1889, Pittsburgh 30, Pa. Canadian Plant—Toronto 6, Ontario.

"Giving Industry A Lift Since 1883"

DUFF-NORTON *Jacks*

This Simple Compressor Meets the Complex Needs of a Changing Petroleum Industry



It's the Nash!

Here is a compressor presenting advantages found in no other device. Nash Compressors have only one moving part, rotating without metallic contact with the pump casing. No internal lubrication is required. Yet they produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure.

There are no valves, gears, pistons, sliding vanes, or other complicated wearing parts in a Nash. Compression is secured by an entirely different principle of operation. Because of this, gas pumping problems difficult with ordinary pumps are often easily handled by the Nash. For example, Nash Pumps are standard equipment in the Synthetic Rubber Industry, where they have met the needs of new and difficult processes.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. They maintain original performance over long periods. Service is assured by a nationwide net-work of Engineering Service offices. Instructive bulletin shows how they operate. Write for it.

- One moving part.
- No internal wearing parts.
- No valves, pistons, or sliding vanes.
- No internal lubrication.
- Low maintenance.
- Slugs of liquid entering pump do no harm.
- Non-pulsating pressure.
- Saves floor space.
- 75 pounds in a single stage.

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Whatever mechanized equipment you make or use—whether it is large, small, rugged, fragile, heavy or light—whether it must operate at high speed, low speed, under water, in acid or under extreme temperature or dust conditions, it will do its job better, more efficiently and more economically if bearing equipped. If it is equipment that lends itself to bearing applications of the thrust type—Aetna has the answer or can come up with it pronto. 37 years of thrust bearing know-how assures this. Inquiries invited. No obligation. Aetna Ball and Roller Bearing Company, 4600 Schubert Ave., Chicago 39, Illinois.

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CLUTCH BEARINGS • Ball thrust clutch release bearing. Banded. Pre-lubricated. T-type, oil impregnated bronze retainer assures concentricity and smooth, quiet, long-life performance.

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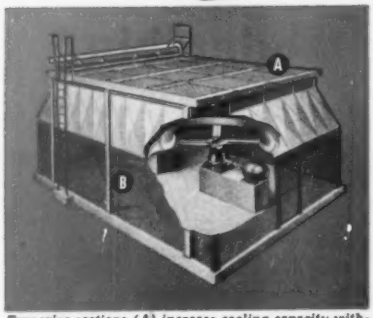
82 YEARS OF PROGRESS WITH THE OIL INDUSTRY

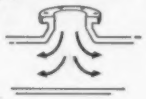
Announcing the NEW improved . . . .



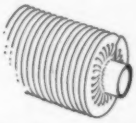
Transaire sections (A) increase cooling capacity without increasing horsepower. They are adaptable to almost any duty involving pressure to 5,000 psi and temperatures to 1,500°F. Fluor steel structures (B) are prefabricated to simplify field erection. Gears and fans in many sizes permit the proper combination for every requirement.

The new Fluor Fin-Fan now comes equipped with *Transaire Sections,* an improved heat transfer surface that holds velocity pressure loss to a minimum, provides smoother flow into and out of tubes, increases the safety factor, reduces operating and maintenance costs and can be assembled and dismantled for cleaning and replacements more easily than any other air-cooled heat exchanger of conventional design.

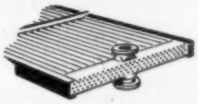
Fluor structures and mechanical equipment, with a remarkable field performance record since 1940, have been retained. Now for the first time the Fluor Fin-Fan is completely selected and supplied by Fluor. More Fluor Fin-Fans are in operation throughout the world today, and regardless of wind and water conditions, you can depend on Fluor Fin-Fans for dependable cooling service.



Less pressure drop. Inlet and outlet nozzles in the header-manifold widen out below the flange for smoother flow through the section and with less pressure drop. Area of these openings is equal to a full pipe cross-sectional area. Countersunk tube holes inside the header reduce turbulence.



More heat transfer surface. Tubes are helically wrapped with a crimped fin which presents more metal-to-metal contact and more contact to passing air for greater dissipation of heat. Tubes and fins are available in a choice of materials. Single units can be used for multiple duties.



Four-to-one safety factor. Headers are either cast iron or fabricated steel and in either case are *unconditionally guaranteed* to withstand test pressures of four times the design pressure. Brass header plugs provide quick easy access to tube ends for cleaning without requiring special tools.

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For complete information on Fluor Fin-Fans write for Bulletin FF-1535-2.

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20 ft stroke length
7 strokes per minute
35,000 lb polished rod
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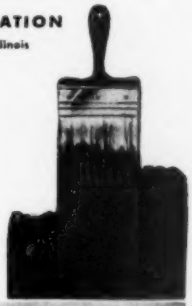

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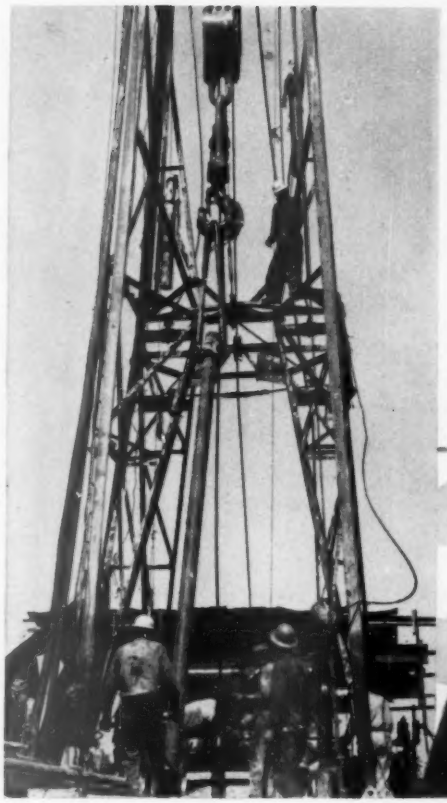

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CASE HISTORY NO. 527-2

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INSTALLATION: Three GM Diesel "Twin-6" torque converter units driving an Ideal 125 draw works and two Ideal C 350 mud pumps; GM 3-71 Diesel drives a generator set.

PERFORMANCE: Engines have operated 6,000 hours since they were installed, without causing delay or requiring repairs. Tool Pusher Bob Davidson says the engines are compact for their power and provide greater flexibility and better portability.

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Many users report one spray with Du Pont "Ammate" kills brush so thoroughly that repeat sprays are not needed for years.

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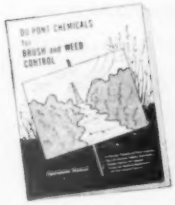
- **Kills roots of brush as well as tops, yet allows low-growing natural cover to come back.**
- **Control lasts for years, saves labor of hand cutting or annual spraying.**
- **Reducing to a minimum the hazard of damage by spray drift.**
- **Not hazardous to operators, livestock or wildlife. Nonflammable.**



Free illustrated booklet describes how to control brush in rights of way with Du Pont "Ammate" weed and brush killer. For your copy, write Du Pont, Grasselli Chemicals Dept., Wilmington, Del.

On all chemicals always follow directions for application. Where warning or caution statements on use of the product are given, read them carefully.

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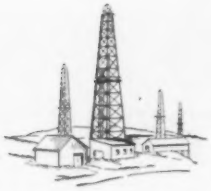
HARNISCHFEGER CORPORATION
CRYSTAL LAKE, ILLINOIS

the P&H *Line*



Do your check valves last less than 30 days?

If they do, then you will be interested in Kennametal Balls and Seats. You'll find that they can give 20 times longer service than alloy steel*, resist shock, pitting, sand cutting, and corrosion far better. (Often they last for a year or more, even in severe sand cut fluid.) Round tripping costs can be greatly reduced, and production increased due to more continuous pumping.

Kennametal sintered-carbide Balls and Seats retain bottom hole valving efficiency due to their extreme "diamond-like" hardness. Their wear and corrosive resistance provide unexcelled performance in sand, sour crude, hydrogen sulphides, water and gas cut fluids.

Consider that a single round tripping of string costs many times more than the highest-priced or largest Kennametal Ball and Seat. For this reason, many fields are standardizing on Kennametal. Also, it is for this reason that they are incorporated in most leading pumps as standard equipment. A complete line of Kennametal API sintered carbide Balls and Seats (in both plain and rib styles) is available from your supplier.

**As proved by comparative performance in both the Mid-Continent and West Coast Fields.*

KENNAMETAL

PUTS AN END TO DOWN-THE-HOLE VALVE CHECK TROUBLE

Quality Sintered Carbide API Balls and Seats

Manufactured by

Kennametal Inc., Latrobe, Pa.

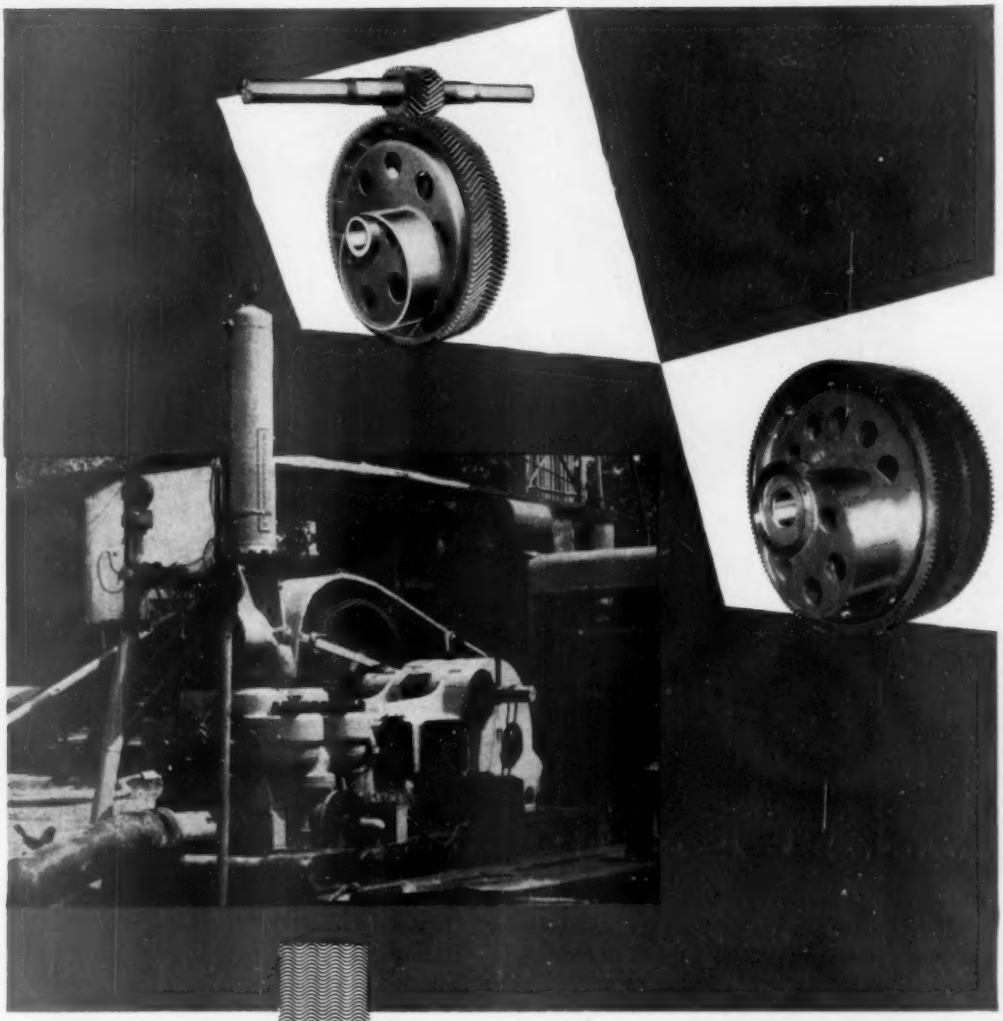
SOLD BY YOUR REGULAR SUPPLIER

From faraway places—more oil for you

In Sumatra back in 1924, Standard Oil Company of California geologists began mapping possible deposits of oil. But not until last year did Sumatran wells start adding to available oil supplies. This operation, costing some $62 million to date, was pioneered by Standard. It is now carried on jointly with The Texas Company under the name "Caltex."

Into San Francisco Bay come tankers carrying Sumatran crude—returns on the gamble Standard undertook nearly 30 years ago. Other shipments go elsewhere in the world, aiding progress and adding defensive strength. Four friendly nations in particular benefit directly. First, of course, is the young Indonesian Republic, of which Sumatra is a part. Then Australia, Japan and the Philippines. They produce practically no oil of their own, but will be supplied in the near future by refineries which Caltex is helping to build. ¶ And, of course, the Sumatran oil brought into this country helps keep you in gasoline and the many other petroleum products you've come to rely on. ¶ The foreign activities of Standard Oil Company of California, typified by this flow of crude from faraway Sumatra, are constantly being expanded, as an added guarantee that petroleum needs of the free world will continue to be met.

STANDARD OIL COMPANY OF CALIFORNIA ***plans ahead to serve you better***



Dallas • Houston • Tulsa • St. Louis
Los Angeles • San Francisco • New York
Chicago • Pittsburgh • Denver
New Orleans

Continental Supply Co.,
Continental Bldg., Dallas, Texas
Export Division: 30 Rockefeller Plaza,
New York, N. Y.

Republic Supply Co., (Of Calif.),
2600 E. Eastland Ave.,
Los Angeles, Calif.

S-M-O-O-T-H!

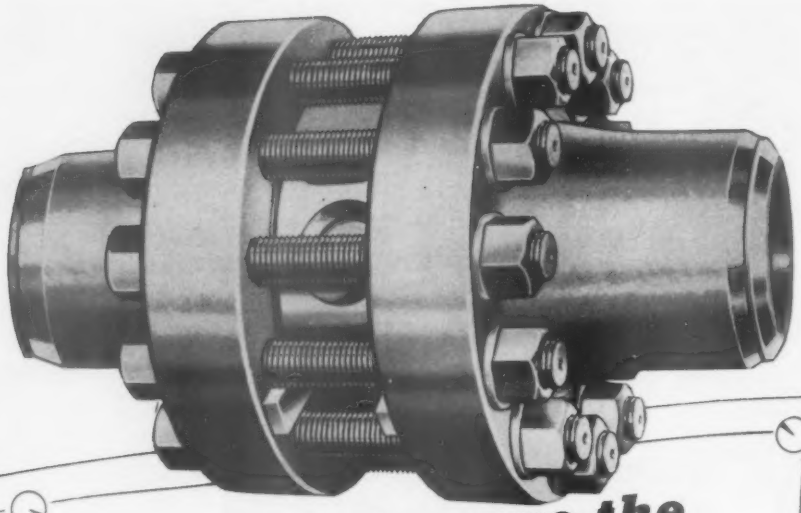
The precision-cut herringbone or double helical gears on a Gardner-Denver Mud Pump transmit power smoothly—withstand sudden high plunger loads without flinching. For complete specifications, ask for Bulletins FX-10 and P-70.

SINCE 1859

GARDNER-DENVER

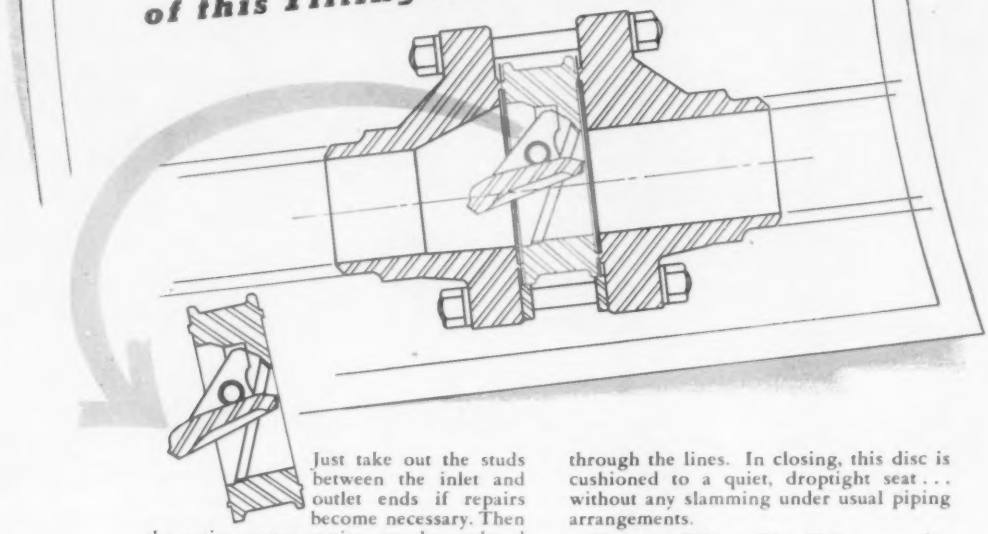
Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd.,
14 Curity Avenue, Toronto 13, Ontario

THE QUALITY LEADER IN COMPRESSORS, PUMPS AND ROCK DRILLS



You Can Remove the Center Section

of this Tilting Disc Check Valve



Just take out the studs between the inlet and outlet ends if repairs become necessary. Then the entire center section can be replaced . . . quickly and easily. No need to cut the valve out of a welded line.

The Tilting Disc Check Valve has the advantage of smooth, easy operation because of the balanced disc, which rides steadily and without fluttering in the flow through the lines. In closing, this disc is cushioned to a quiet, droptight seat . . . without any slamming under usual piping arrangements.

Chapman Tilting Disc Valves are also available in the standard two-piece design, in either iron or steel, for all pressures. Write for full details and prices to

The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASS.

CHAPMAN 3-PIECE (TILTING DISC) **CHECK VALVES**

Engineered FOR SMOOTH FLOW

TUBE-TURN Eccentric Reducers are designed with strong knuckle contours and as gentle transitions from large to small diameters as possible. In addition to providing smooth inner walls at the joints, these features hold turbulence and pressure loss to a minimum.

Efficient piping flow reduces pumping power requirements, and investment in equipment. For efficient, leakproof piping, specify welded systems—using TUBE-TURN Welding Fittings and Flanges.

You'll find a TUBE TURNS' Distributor in every principal city. Call him for good service in good connections.

Be sure you see the double "tt"

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles

Subsidiaries: TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO

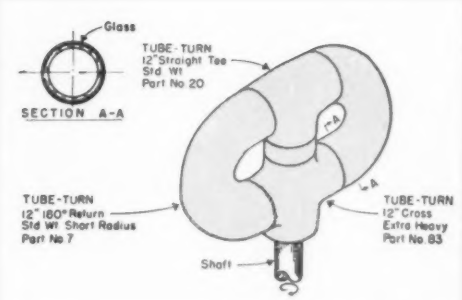
PENNSYLVANIA FORGE CORPORATION, PHILADELPHIA, PA. • KEROTEST MANUFACTURING COMPANY, PITTSBURGH, PA.

TUBE TURNS' *Engineering Service*

HELPS SOLVE A VIBRATION PROBLEM

TUBULAR CONSTRUCTION often solves tough machine design problems and here, as in piping problems, Tube Turns' Engineering Service is ready to help you! For example:

Vibration was cracking the glass coating of a plate type agitator for a brine tank in a chemical plant. After repeated replacements, the engineers decided to switch to tubular construction and called in Tube Turns' Engineering Service for design assistance. The resultant design, shown in the sketch, embodies great rigidity and is not affected by the vibration. The expensive maintenance caused by cracking of the agitator's glass coating was eliminated.



FABRICATION IS FAST. Field or shop fabrication of piping assemblies is easier when welders can count on the dimensional accuracy of TUBE-TURN Welding Fittings. True circularity and uniform wall thickness assure perfect lineup and fit.

AT SNYDER GASOLINE PLANT. TUBE-TURN Welding Fittings and Flanges play an important part in the miles of piping for this unique casinghead gas processing plant, operated by Sunray Oil Corporation in West Texas. The $8,000,000 plant, built by the Mid-Continent Division of the Fluor Corporation, Ltd., produces about 500,000 gallons of liquid products per day. Its welded piping with TUBE-TURN Welding Fittings and Flanges provides leakproof permanence and helps assure absolute safety and reliability.

TUBE TURNS, INC., Dept. J-3
224 East Broadway • Louisville 1, Kentucky

Your name .....

Position .....

Company .....

Nature of business .....

Address .....

City ..... *State* .....

DISTRICT OFFICES

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Chicago	Los Angeles

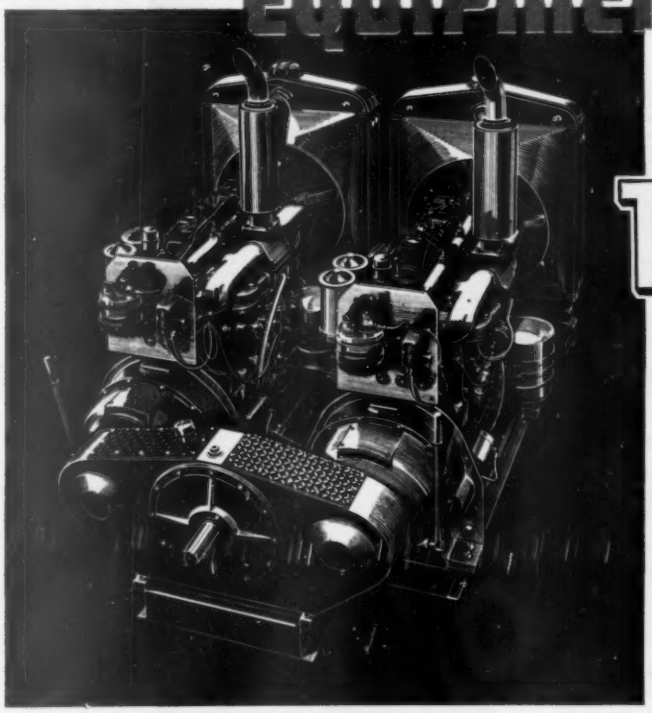
"TT" and "TUBE-TURN" Reg. U. S. Pat. Off.

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

Oil Fields are Using More and More

CONTINENTAL-POWERED EQUIPMENT



CONTINENTAL MOTORS — *Powerful as the Nation* — AMERICA'S STANDARD

TWO RED SEALS,

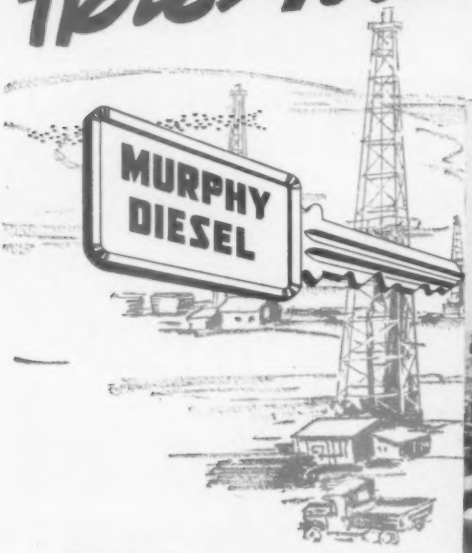
Driving Through One Shaft, Do Some Jobs Better Than the Single and Much Larger Low-Speed Engine Heretofore Used

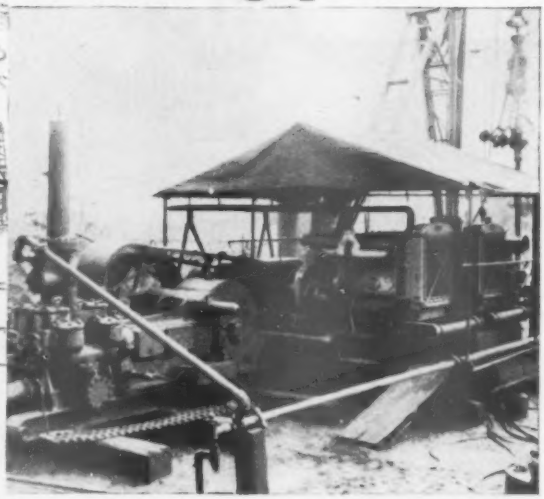
ONE OF THE TRENDS of more than casual interest these days is the trend toward the use of compounded Continental Red Seal engines as a source of oil field power . . . Operators are finding that many jobs requiring power above Continental's limit—jobs for which they have heretofore had to resort to large low-speed engines of some other make—can be done to better advantage by teaming up two identical Red Seals to deliver their output through a common shaft . . . For one thing, the cost of this dual setup is comparable with, and usually less than, that of the single large unit it supplants. Horsepower for horsepower, fuel consumption is lower. The flow of power is smoother because these smaller units operate at substantially higher speeds. Finally, upkeep problems are simplified and parts costs greatly reduced . . . The wide acceptance of Red Seal engines for such compounding speaks well for the dependability which Continental has been building into specialized engines and power units for more than 50 years.

6218 CEDAR SPRINGS ROAD, DALLAS 9, TEXAS • 3817 S. SANTA FE AVE., LOS ANGELES 58, CALIFORNIA

Continental Motors Corporation
MUSKEGON, MICHIGAN

HERE'S YOUR KEY to bigger drilling profits





National 50 drawworks powered by two Murphy Diesels each rated at 190 H.P., continuous, 210 H.P. intermittent. It is owned by Hulme Drilling Co., Great Bend, Kans. and is shown here near Hutchinson, Kans.

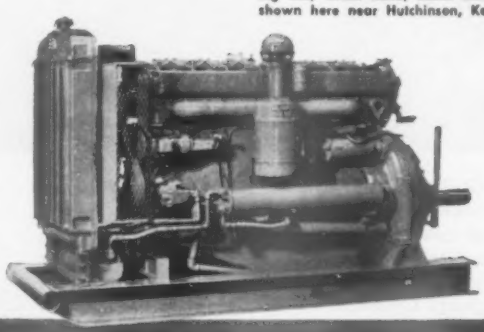
THERE are a lot of factors that determine how much profit you'll get out of any drilling operation, but they all depend on power. Without good, reliable power, the best equipment and the best drilling "know-how" can be wasted.

You can put an end to the power problem with Murphy Diesel power. Murphy Diesels deliver more usable heavy duty drilling power at a lower cost per horse power hour than any other engine of comparable size. Their proved record of dependability and long life adds more to a rosy profit picture.

The reasons why Murphy Diesels are able to deliver more power, greater economy and dependability and longer life are given in the booklet *"10 Questions to Ask a Diesel Engine Salesman"*. Ask your Murphy Diesel Dealer for a copy or write:

MURPHY DIESEL COMPANY

5305 W. Burnham St. Milwaukee 14, Wisconsin
Tulsa Office—Sales, Parts and Service:
113-117 South Elwood Street, Tulsa, Oklahoma



MURPHY DIESEL

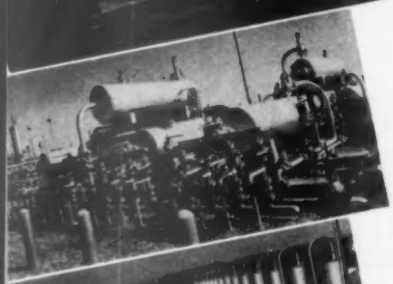
Heavy Duty Power For The Oilfields

Murphy Diesel Engines and Power Units for drilling and pipe line pumping, 90 to 226 H.P., 1200 and 1400 RPM. Generator Sets, 60 to 140 K.W. Dual-Fuel Engines, 135 to 180 H.P. Also Crude Oil Burning Engines.

Sales Parts and Service: Los Angeles, California; Denver, Colorado; Evansville, Indiana; Great Bend, Kansas; Butte and Great Falls, Montana; Albuquerque, New Mexico; Corpus Christi, Dallas, Houston, Lubbock and San Antonio, Texas; Jackson, Mich.; and Edmonton, Alberta, Canada.

249

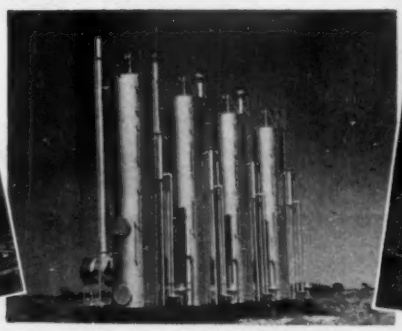
PROGRESS...
KEEPS PARKERSBURG FIRST IN PRESSURE EQUIPMENT!

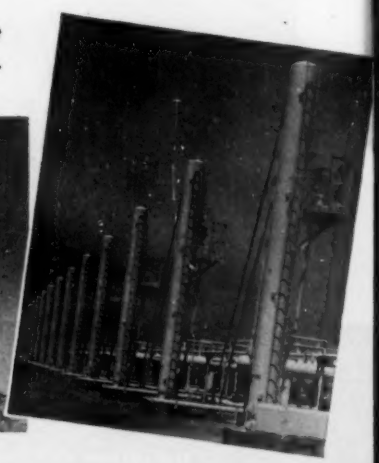


- **FIRST IN PERFORMANCE** means greater efficiency and economy for Parkersburg Gas Processing Units, Separators, Scrubbers, Treaters, Heaters and allied equipment.
- **FIRST IN VALUE** means Parkersburg equipment gives you longer service with less care and maintenance.
- **FIRST IN VARIETY** means Parkersburg has the size, type and pressure-rated equipment for every oil and gas producing condition.
- **FIRST IN SERVICE** because Parkersburg Representatives and pressure equipment engineers work hand in hand with you to plan the installation best suited for your producing conditions.

PESA

See Our Exhibit At the Oil Show.





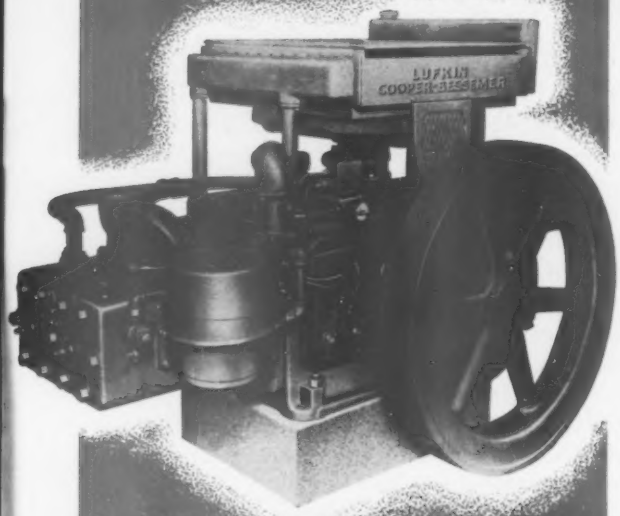
No. 5306

PARKERSBURG
PRESSURE EQUIPMENT

HORIZONTAL AND VERTICAL SEPARATORS • HYRECO • HYDRACEPTER • SCRUBBERS • TREATERS • HEATERS

Manufactured in Houston, Texas

Lufkin



THE ENGINE OF MANY USES WHERE LOW MAINTENANCE, DEPENDABLE LONG LIFE SERVICE IS A NECESSITY

GSDH — 40-60 H. P.
Gas
ENGINES

2 CYLINDER 2 CYCLE
400-600 RPM . . .

HORIZONTAL RADIATOR
FOR NON-DIRECTIONAL COOLING

●

2 CYLINDER 2 CYCLE
FOR SMOOTHNESS

●

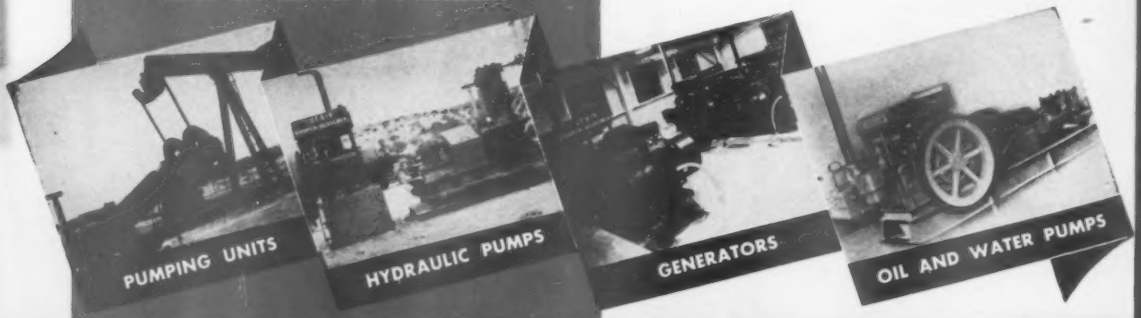
OIL COOLED PISTONS
FOR LONGER RING AND CYLINDER WEAR

●

FULL PRESSURE LUBRICATION
FOR MORE POSITIVE LUBRICATION

●

HEAVY DUTY CROSSHEAD CONSTRUCTION . . . . . .
FOR CONTINUOUS SERVICE

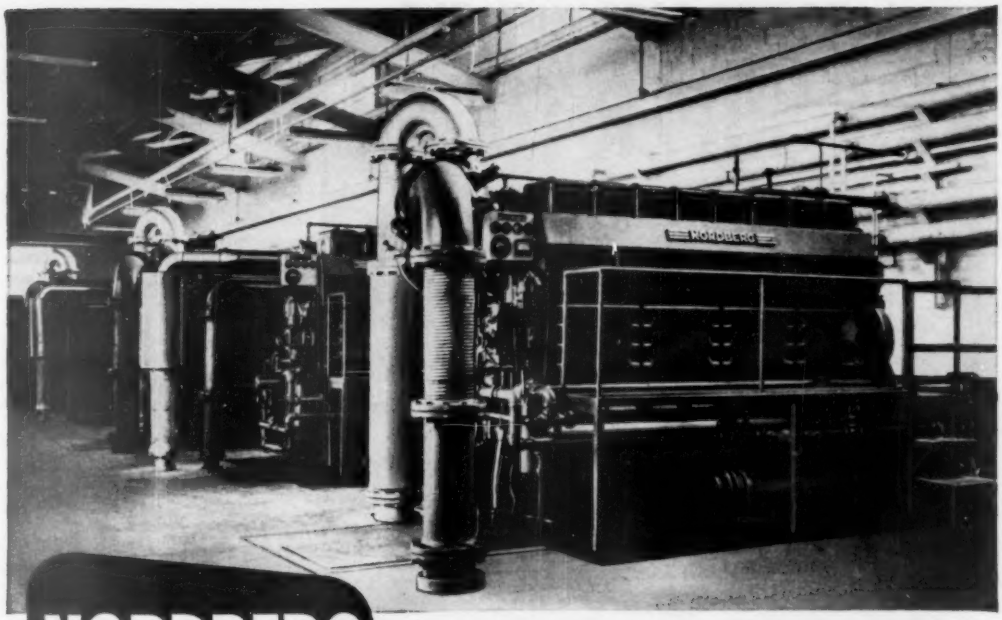


LUFKIN FOUNDRY & MACHINE COMPANY

LUFKIN, TEXAS

Branch sales and service Houston, Dallas, New York, Tulsa, Los Angeles, Seminole, Oklahoma City, Corpus Christi, Odessa, Kilgore, Wichita Falls, Casper, Wyoming, Great Bend, Kansas.
Lufkin Equipment in CANADA is handled by
THE LUFKIN MACHINE CO., LTD. 14321 108th Avenue, Edmonton, Alberta, Canada.

LUFKIN PUMPING UNITS • LUFKIN-COOPER-BESSEMER ENGINES • LUFKIN OIL FIELD AND INDUSTRIAL TRUCK TRAILERS • INDUSTRIAL SPEED REDUCERS AND INCREASERS • DIVISION LUFKIN FOUNDRY & MACHINE COMPANY INDUSTRIAL, MILL AND AUTOMOTIVE SUPPLIES



NORDBERG *Pipe Line* ENGINES

DIESEL • DUAFUEL® and SPARK-FIRED GAS types
from 265 to 4260 horsepower

For trunk and gathering line stations—on crude oil and products lines—wherever you must keep petroleum products on the move with power to spare—you can count on Nordberg Pipe Line Engines of the right size and type to do a dependable, economical job, day-in, day-out.

Hundreds of these rugged engines built by Nordberg and its Busch-Sulzer Division have been thoroughly proved in a wide variety of installations ranging from self-contained portable pumping units for gathering lines to permanent trunk line stations and generating units for station power and lighting. *For complete details, write for Bulletins outlining your power requirements.*

● Nordberg Engines are built in two and four-cycle models in a wide range of sizes from 10 to over 10,000 H.P., including Diesel, Duafuel®, and Spark-Fired Gas Burning types.

NORDBERG MFG. CO., Milwaukee, Wisconsin

6352-R

BUSCH-SULZER A DIVISION OF NORDBERG

NORDBERG DIESEL ENGINES

YOU'RE SAFE WITH THE

NEW SUPER-TOUGH

WILLSON SAFETY HAT

THE NEW WILLSON SAFETY HAT is entirely new in design, material and method of manufacture . . . tough as metal and more resilient! Here are some other outstanding features of the new Willson Super-Tough* Safety Hat . . .

streamlined contour—deflects objects more effectively and provides a greater safety "pocket" inside.

new suspension design—adjustable "hammock" headband is suspended *inside* at 6 points. No exposed rivets or lacing—no holes through hat.

comfortably cool—space between headband and shell provides ample air circulation for wearer.

moisture resistant—practically 100% waterproof and resists many caustics and acids.

Passes all required tests with an extra margin of safety!

Write for your copy of the new bulletin describing the Willson Super-Tough* Safety Hat.

*trademark

More than 300 Safety Products Carry This Famous Trademark

WILLSON®

Established 1870

WILLSON PRODUCTS, INC., 204 Washington Street, READING, PA.

They Say—

Why Offshore Oil Is Needed

"The Census Bureau has predicted that by 1975 there will be 193,000,000 of us, and that we shall be driving 65,000,000 automobiles and 20,000,000 trucks. Fuel oil is in heavy demand for power on land and sea. It is easy to understand that by 1975 we shall need more than twice the amount of oil that we produced in 1950. And the demand for natural gas will be 15 trillion cubic feet instead of the 6.5 trillion distributed in 1950.

"All this makes one wonder whether or not the conservationists who fear an oil shortage in the next two decades are alarmists. If the authoritative Dr. Wallace E. Pratt, veteran retired geologist of Standard Oil Co. (N. J.), is right—and he usually is right—there are at least 1,000 billion barrels of oil beneath the world's continental shelves, which is about 500 times the present world consumption. At least a tenth of this store lies under the waters of the United States."

Editorial in the New York Times.

Cost Must Include Profit

"We do a disservice to ourselves and the consumer if we try to leave him with the blissful idea that oil can be provided at a figure cheaper than the cost plus a reasonable profit."

R. F. Windfohr, president of the Texas Mid-Continent Oil and Gas Association, addressing the Abilene, Tex., Chamber of Commerce.

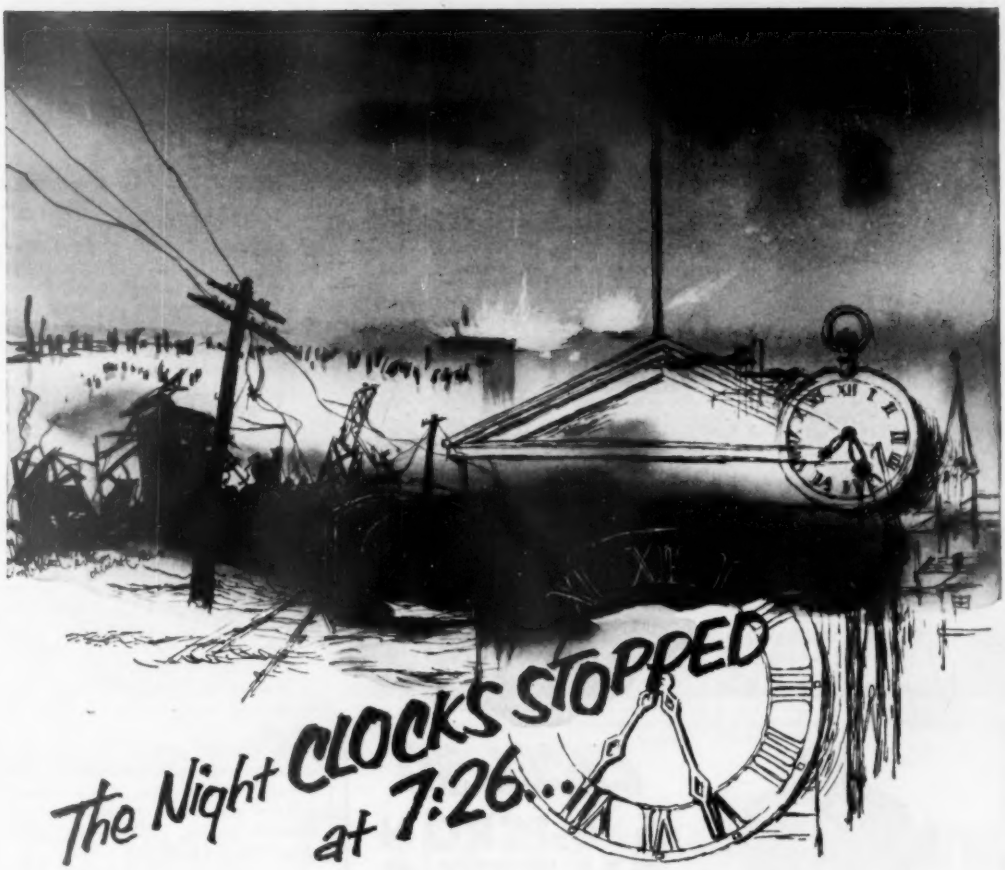
Oil Editors Scolded

"Farmers of this country use more than 210,000,000 bbl. of petroleum products annually. . . .

"In view of this, it is interesting to consider how some spokesmen for the industry act toward farmers. We have in mind especially those editors of oil trade journals who keep up a drumfire of criticism of farmer cooperatives.

"Farmers may be the biggest customer group in the oil industry, but in view of these editors the farmers should keep their noses out of any phase of oil production, refining and marketing.

"An attack on co-ops is an attack on a way of doing business that farmers generally have come to accept. It is an attack on farmers. What a strange way to show respect for the



Some 9,500 people were in South Amboy, N. J., that drizzly evening in 1950. At the waterfront, longshoremen were transferring the last of 12 freight cars of ammunition to lighters that would carry it to a waiting vessel in Raritan Bay.

But the City Hall clock never got to 7:27—and the freighter's deadly cargo never got loaded. Explosions shattered windows over a radius of 12 miles; and hundreds of people looked at their arms and legs and saw that flying daggers of glass had stabbed them.

At dawn, 312 of the injured had been counted.

★ ★ ★

Such disasters have happened many times before in America. They could happen again. And *if* they do—and *when* they do—there must be blood plasma on hand to take care of the injured. For blood saves lives!

But blood cannot be mined or manufactured. It must come from the veins of healthy men and women. Men and women who feel concern for a suffering neighbor. So give blood—now! Whether your blood goes for Civil Defense needs, to a combat area, or to a local hospital—this priceless, painless gift will some day save an American life!

Give Blood Now

CALL YOUR RED CROSS TODAY!

National Blood Program

Business Executives!

✓Check These Questions!

If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- ☐ Have you given your employees time off to make blood donations?
- ☐ Do you have a Blood Donor Honor Roll in your company?
- ☐ Have you set up a list of volunteers so that efficient plans can be made for scheduling donors?
- ☐ Have you arranged to have a Bloodmobile make regular visits?
- ☐ Has your management endorsed the local Blood Donor Program?
- ☐ Have you informed employees of your company's plan of co-operation?
- ☐ Was this information given through Plant Bulletin or House Magazine?
- ☐ Has your company given any recognition to donors?
- ☐ Have you conducted a Donor Pledge Campaign in your company?

Remember, as long as a *single* pint of blood may mean the difference between life and death for *any* American . . . the need for blood is *urgent!*

Rugged, extra-strength BLOCKS engineered for oil industry needs

SHOWN at left is a Model 4140 Washington moving block of 30-ton capacity, designed for 1½" wire rope. Manganese sheave, cast steel sides, bronze bushed—an extra strong, *economical* block for heavy moving and construction work.

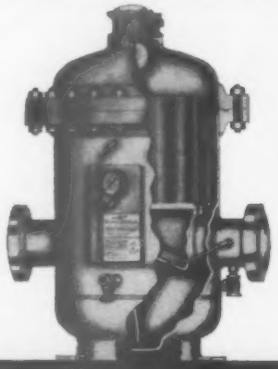
Other models of Washington blocks adaptable to oil field construction and operation include cat blocks, rigging blocks, snatch blocks and hoisting blocks. All are designed for extra strength and long life. All are backed by outstanding manufacturing facilities and specialized experience in block production.

Write for Catalog No. 35, showing the full line of Washington blocks, fairleaders and related equipment. Address Washington Iron Works, 1500 6th Ave. South, Seattle 4, Washington.

WASHINGTON IRON WORKS

Since - 1882

WASHINGTON IRON WORKS



EXCEL-SO

5 MICRON FILTERS

for finished **PETROLEUM PRODUCTS**

Designed to remove dirt (down to 5 microns) from finished petroleum products . . . removal of this microscopic rouge lengthens the life of jet and gasoline aircraft engines, pumps, meters, valves, and fittings. They are compact in size and are built for operating pressures from 0-2500 psi. EXCEL-SO Filters can be built to any code requirement, API-ASME, ASME or state codes for unfired pressure vessels. They also meet requirements of JAN or MIL specifications. Available in capacities from 10-2000 G.P.M. Special "Throwaway" Plastic Filter Bundle available on request. Write for Bulletin FO-52.

WARNER LEWIS COMPANY

BOX 3096 • TULSA, OKLAHOMA

most important customer group the industry has."

Editorial in the Cooperative Consumer, published by Consumers Cooperative Association.

Advice on Legislation

"Never forget a bad law can cost you your job or your business. All your pains, all your hard work, and all your investment—can be wiped out by that single piece of paper your legislator didn't fully understand. So if you want to protect your business, it is up to you to see that your legislator not only understands bills that affect you—but also understands your business problems generally."

Clarel B. Mapes, general secretary of the Mid-Continent Oil and Gas Association, addressing the Oil Men's Club of Kansas City.

Competition to Be Tougher

"You can be sure that competition is going to be tougher. I don't mean in the dim future; I mean right now, this year. All the signs point to intense competition. There are four very strong reasons for anticipating an increase in the intensity of competition in the Midwest:

"1. Crude-oil pipe-line capacity is being and will be substantially increased.

"2. Refinery construction is increasing more rapidly in the Midwest than anywhere else. This would indicate that the midwestern market may considerably reduce its dependence upon shipments from District 3. But—

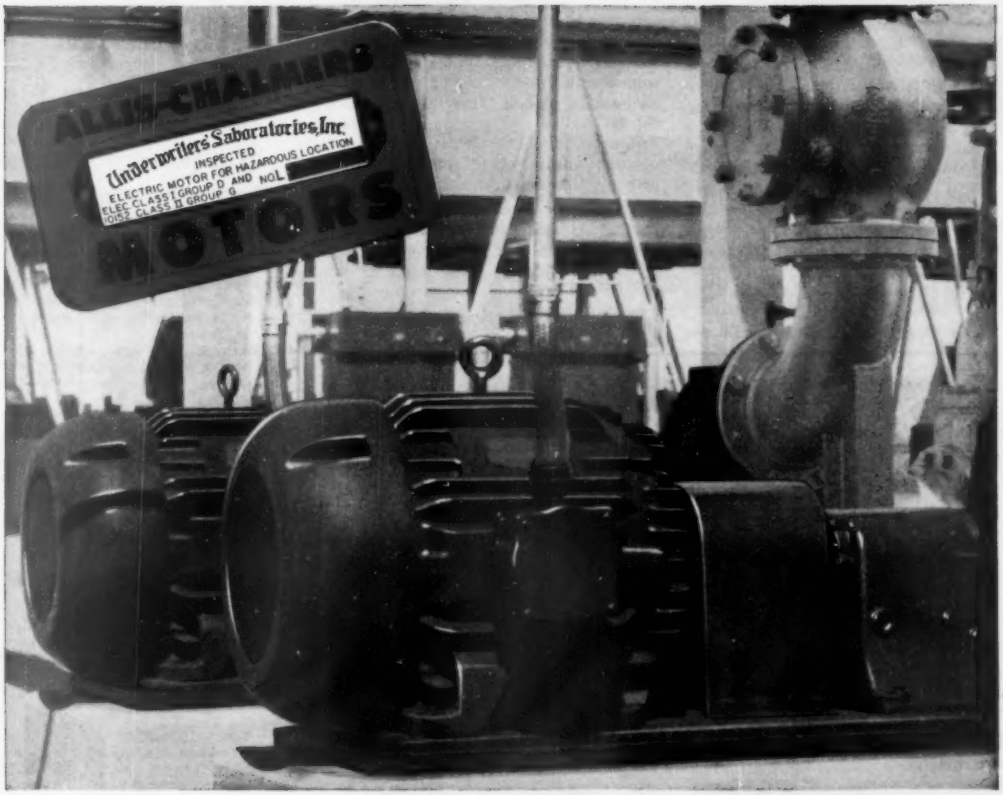
"3. I have seen no evidence as yet that the suppliers in Dist. 3 who have been selling in our area show any inclination to surrender without a fight the part of this market they have gained over the years. Deliveries by products pipe lines have been increased and are being expanded.

"4. Furthermore we may expect new competitive pressures on our market to come from Canada and the Williston basin. It will be only a matter of time until these new sources of crude exert a strong influence on refining, transportation, and marketing patterns in the Midwest."

Dwight G. Benton, vice president of Standard Oil Co. (Ind.), addressing the Wisconsin Petroleum Association, Milwaukee.

Foreign Reserves Needed

"Our activities in foreign countries strengthen, we believe, our long-range position in the United States. The fact is that our country uses about 60 per cent of the oil now produced in the



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world, yet has within its own borders less than 30 per cent of the world's known reserves.

"There is no present need for concern about this situation. However, as long as it exists and as long as the world runs on oil, it seems prudent for American interests to maintain substantial participation in reserves beyond our national frontiers to provide for America's possible future needs. This can only be brought about by developing these reserves at a pace consistent with the requirements of the countries in which they are located.

"We are keenly conscious of the fact this must be done without damaging our domestic industry. A good way to meet the situation, it has seemed to us, is to build an integrated oil business abroad. Thereby we benefit the people and economies in the various foreign countries where we operate, thus linking their welfare with our own.

"We hope one of the very important results of this policy will be that Americans will have oil as long as it is available anywhere in the world."

George V. Holton, chairman, Socony-Vacuum Oil Co., Inc., in a letter to stockholders.

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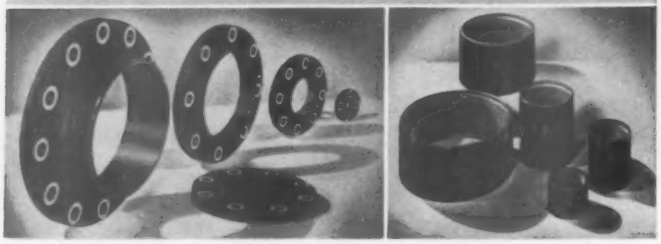

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CALENDAR

APRIL

Apr. 1 Mid-West Gas Association, Broadmoor Hotel, Colorado Springs, Colo.

1- 9 American Association of Oilwell Drilling Contractors, eighth annual drilling industry safety clinic, Baker Hotel, Dallas.

7- 8 American Gas Association, research and utilization conference, Hotel Statler, Cleveland.

7- 9 Petroleum Industry Electrical Association, annual convention and exhibit, Shamrock Hotel, Houston.

8- 9 American Association of Oilwell Drilling Contractors, eighth annual drilling industry safety clinic, Baker Hotel, Dallas.

8-10 American Petroleum Institute, division of production, Eastern district meeting, William Penn Hotel, Pittsburgh.

9-10 Petroleum Engineering Conference, University of Kansas, Lawrence.

9-10 American Association of Oilwell Drilling Contractors, eighth annual drilling industry safety clinic, Baker Hotel, Dallas.

10 San Joaquin Valley Oil Producers Association, annual dinner meeting, Bakersfield Inn, Bakersfield, Calif.

13-15 American Society of Lubricating Engineers, eighth annual meeting, Hotel Statler, Boston.

15-17 National Petroleum Association, midyear meeting, Cleveland.

20-22 American Petroleum Institute, Division of Transportation, products pipe-line conference, Hotel Muehlebach, Kansas City.

21 Association of Consulting Chemists and Chemical Engineers, Inc., Hotel Belmont Plaza, New York City, symposium and dinner.

21-23 Southwestern Gas Measurement Short Course University of Oklahoma, Norman.

22-23 Texas Petroleum Research Committee, sixth oil-recovery conference, Texas A. & M. College, College Station.

22-24 American Association of Petroleum Geologists, Rocky Mountain section meeting, Casper, Wyo.

22-24 American Institute of Electrical Engineers, southern district meeting, Hotel Seelbach, Louisville, Ky.

24-25 Interstate Oil Compact Commission, spring meeting, Roosevelt Hotel, New Orleans.

26-29 American Institute of Chemical Engineers, Chemical Institute of Canada, joint meeting, Royal York Hotel, Toronto, Ont.

27-28 Independent Petroleum Association of America, mid-year meeting, Jefferson Hotel, St. Louis.

APRIL 27-MAY 1 American Petroleum Institute, safety and fire protection committees sixth mid-year meeting, Galveston, Tex.

Apr. 29-May 1 Natural Gasoline Association of America, annual convention, Rice Hotel, Houston.

Apr. 30-May 1 American Gas Association, transmission and storage conference, Edgewater Beach Hotel, Chicago.

MAY

4- 5 American Petroleum Institute, division of marketing, midyear meeting, Baker Hotel, Dallas.

4- 6 Liquefied Petroleum Gas Association, annual convention, Conrad Hilton Hotel, Chicago.

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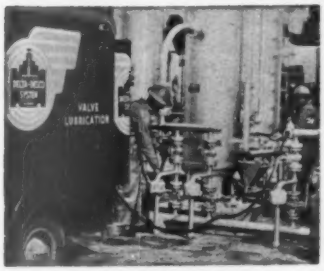

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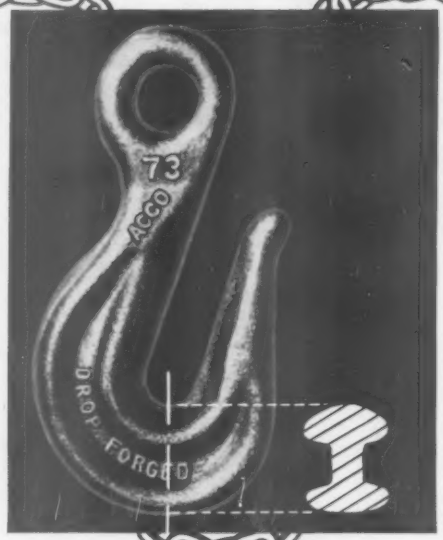

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5- 6	Gas hydrate control conference, University of Oklahoma, Norman.
6- 8	American Society of Training Directors, ninth annual conference, Sheraton Plaza Hotel, Boston.
7- 8	American Petroleum Institute, Rocky Mountain district, Division of Production, spring meeting, Gladstone Hotel, Casper.
8	Society of Exploration Geophysicists, Pacific Coast Section, annual spring meeting, Hotel El Tejon, Bakersfield, Calif.
11-13	Southern Gas Association, Jung Hotel, New Orleans.
11-14	American Petroleum Institute, Division of Refining, midyear meeting, New York.
13-14	Pacific Coast Gas Association, annual gas supply and transmission conference, Santa Barbara, Calif.
14-23	International Petroleum Exposition, Tulsa.
15-16	International Gas Union, council meeting, Paris, France.
19-22	The Institute of Gas Engineers, ninetieth annual meeting, London, England.
21-23	Panhandle Geological Society, field trip, Yucca Hotel, Raton, N. M.
24-27	American Gas Association, production and chemical conference, Hotel New Yorker, New York City.
25-29	American Society of Mechanical Engineers, annual conference and exhibit, oil and gas power division, Hotel Schroeder, Milwaukee.
27-29	Texas College of Arts and Industries, Kingsville, eighth annual short course in gas technology.
28-29	Western Petroleum Refiners Association, regional technical-industrial relations meeting, Broadview Hotel, Wichita.
28-29	Natural Gas and Petroleum Association of Canada, London, Ont.
29-30	West Texas Geological Society spring field trip, Paisano Hotel, Marfa, Tex.

JUNE

2- 3	American Petroleum Institute, Division of Production, Pacific Coast District, Statler Hotel, Los Angeles.
4- 5	Kentucky Oil and Gas Association, annual meeting, Lafayette Hotel, Lexington, Ky.
7-12	Society of Automotive Engineers, summer meeting, The Ambassador and Ritz-Carlton Hotels, Atlantic City, N. J.
14-18	Canadian Gas Association, Windsor Hotel, Montreal, Canada.
15-19	American Petroleum Institute, Division of Production, midyear committee conference, Hotel William Penn, Pittsburgh.
16-19	American Welding Society, national spring technical meeting, Shamrock Hotel, Houston.

JUNE 16-JULY

2	Intensive Course and Research Conference on Phase Behavior of the Hydrocarbons, University of Michigan, College of Engineering, Ann Arbor.
18-19	Western Petroleum Refiners Association, regional technical-industrial relations meeting, Conrad Hilton Hotel, Chicago.
18-19	Pennsylvania Grade Crude Oil Association, annual meeting, Hotel William Penn, Pittsburgh.

June 28-July 2 Petroleum Equipment Suppliers Association, annual meeting, Broadmoor Hotel, Colorado Springs, Colo.

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THE OIL AND GAS
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TULSA, OKLAHOMA

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JOURNALLY Speaking

On the Rocks

GEOLOGISTS ought to be in clover, what with the world headed for the rocks. So says a cynical friend. But there's no doubt but that the oil industry would have been on the rocks long ago if it hadn't put geologists on the rocks.

When these rock hounds first started scrambling around the countryside chipping off hunks of outcrops and peering down farmers' wells they got the old hee-haw (and sometimes the old heave-ho) from the "creekologists," doodlebuggers, and other contemporary experts in well location. But in due course the value of geologists in finding oil became recognized and more and more companies began putting geologists on the rocks and thus kept their finances off of the same.

They are still called rock hounds, though more affectionately than derisively, but most of them nowadays spend very little time clambering around with rock hammers. Instead they are in their offices studying such invaluable literature as the special exploration section in this issue of our favorite oil publication.

Just the Sort

ACCORDING to an authoritative source of petroleum daffynitions, a geologist is a man who makes a study of the past and then gets a job with an oil company predicting the future.

This same authority informs us that a geophysicist is a geologist who has taken physics. A geologist would have to take a lot more physics than we got in high school to understand all the intricacies and involvements that have got into the mysterious and abstruse art of oil finding. If you doubt this, take a gander at some of the graphs, equations, and squiggles in the technical articles in this issue. They make the old psychic art of doodlebugging seem simple by comparison.

However, for people who like this sort of thing, this is just the sort of thing they like. And this study of the past, plus an ample dose of physics, does help geologists predict the future for the oil industry. But if geologists are striving for 100 per cent perfection in the predicting business they still have quite a way to go, as witness Fred Lahee's article on page 138. He points out that last year geologists were right 16 per cent of the time in locating wildcats while wild wildcatters were right only 3 per cent of the time.

It is said that to be successful in the stock market you have to be right 51 per cent of the time, but wildcatters, on the whole, make out with a much lower percentage of good guesses. That's why the stakes have to be so high in the oil business.

Pool Guide

THERE'S a pool guide in this issue, but it has nothing to do with red and white balls on a green table nor yet with places to take a refreshing plunge on hot days. Whatever variety of pool may interest oil men in their leisure moments, the pools they are most interested in are oil and gas pools, and this is the kind of pool guide we're talking about.

It's a mighty fancy and mighty handy guide, too—16 maps of the pool locations in as many of the principal producing areas of the United States. These maps are not detailed enough to plot a drilling program, but they are big enough to permit you to spot new wildcats and yet small enough to keep in your top desk drawer or even carry in your pocket. And in all places where the land surveys follow a regular and logical pattern — which excludes Texas — the township lines permit the reasonably accurate spotting of any well location.

We figured that these maps would be so handy and so popular that we had a lot of extra copies printed up and bound as a little booklet with a yellow cover. Our Reader Service Department will be more than delighted to let you have as many copies as you want for the really nominal price of $3 per each. That's cheap at half the price, and an easy way to improve your pool knowledge.

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Science is wonderful, but oil is found by men

SEVERAL pertinent facts about oil finding are contained in the special articles on exploration in this issue of the Journal. Such as:

- Geophysical and other exploratory activity was at a new high last year.
- Present proved reserves are not high in terms of years' supply.
- New-field wildcats located with technical advice were four times as successful as those located without technical advice.
- Small companies and independent operators drilled four times as many wildcats as major companies did.

SEVERAL pertinent observations can be based on those facts. Such as:

The oil industry's primary responsibility to the nation is to provide adequate supplies of oil. This requires a continuous exploration program based on probable needs several years hence rather than on current market demands. And because oil is becoming more difficult and more expensive to find, and because the demand increases year by year, both the amount and the efficiency of exploratory work must keep increasing.

The application of science to oil finding is increasing steadily and is proving its worth. There may never be a sure way of determining the presence of oil prior to drilling, but the tremendous amount of research into the interpretation and application of present scientific knowledge is bringing results in finding more oil.

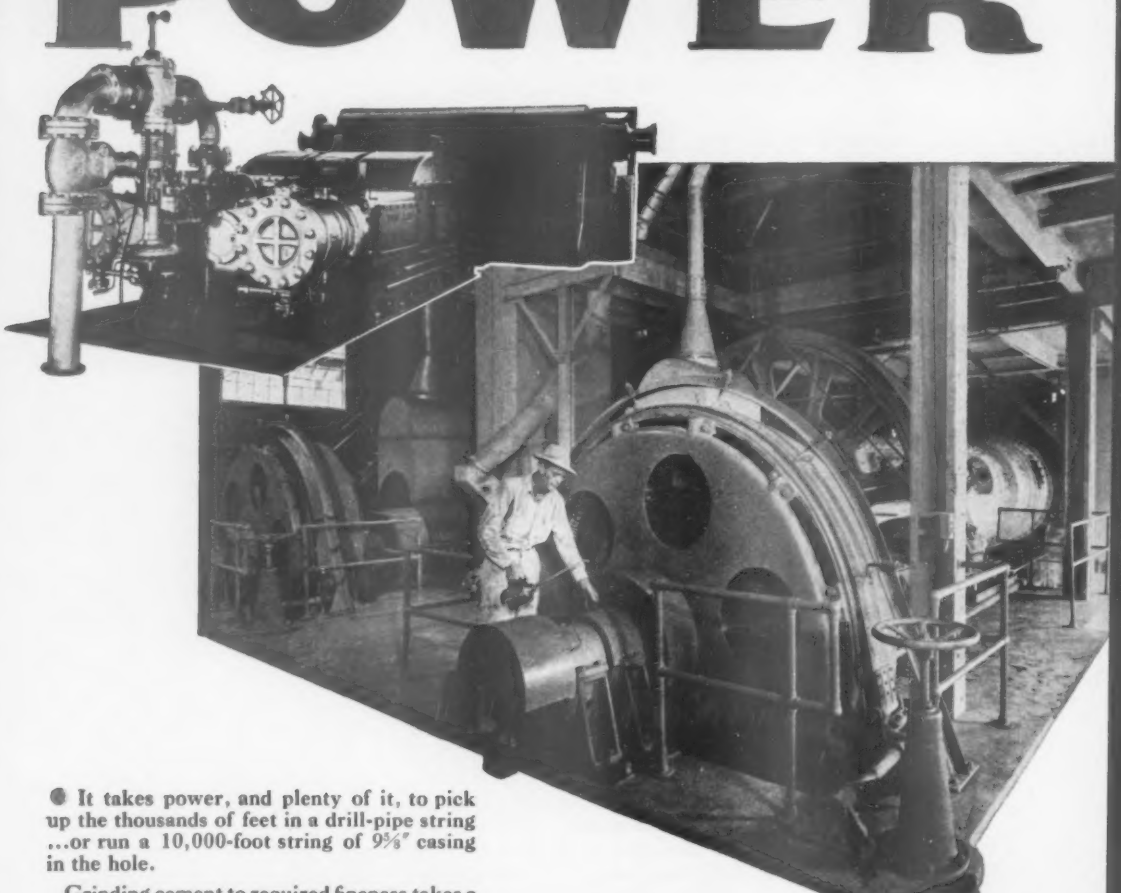
The once-common notion that a decline in the ratio of proven reserves to current consumption is a certain sign that the nation was running out of oil has been pretty well scotched by the advances in technology in recent years. Oil men have sound basis for believing that they will continue to find more oil, and the general public has come to have great confidence in the omnipotence of present-day science.

BUT for all the advances in the science of oil finding technology alone will not find oil. Oil is found by men who dare to take big risks, who use all the technological aids available but add those necessary human elements of faith, hope, and determination. It takes a lot of what has been called "discovery thinking" to make the instruments and equations of value in finding oil.

That is probably why more wildcatting is done by small operators than by big companies—because these independents are more willing to work on hunches; in other words, because the human elements of progress are more dominant.

As long as the oil industry continues its scientific research but does not lose its incentives for individual judgment and initiative, it will continue to find oil.

POWER



● It takes power, and plenty of it, to pick up the thousands of feet in a drill-pipe string ...or run a 10,000-foot string of 9⅝" casing in the hole.

Grinding cement to required fineness takes a lot of horsepower, too. This finish mill (shown at right) is a steel cylinder 9'-6" in diameter by 40' in length, weighing 285,000 lbs., charged with 165,000 lbs. of steel balls . . . making a total load of 450,000 lbs. A 1000-horsepower electric motor spins this loaded cylinder at 24 revolutions per minute, in producing 600 sacks of cement an hour — quality cement, made to meet the exacting demands of the Oil Industry.

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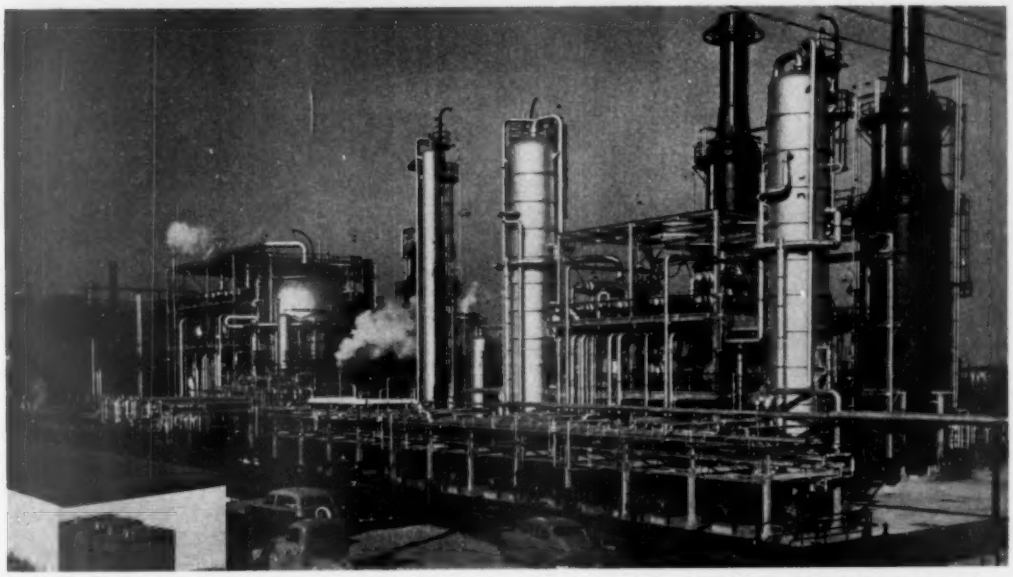


NEWEST UNITS in Union Oil Co.'s Wilmington refinery are these two 20,000-bbl. topping units and, at left, the vacuum flasher tower, one of the largest in the United States. Completion of the units winds up a modernization and expansion program which increased the refinery's capacity from 65,000 to 100,000 bbl. per day. One of the topping units handles a blend of heavy San Joaquin Valley crude and heavy coker gas from Union's Oleum refinery. The other was built to process either light or asphaltic crude.

CONSERVATION.—Texas Railroad Commission orders producing wells in huge Spraberry trend of West Texas shut in effective April 1 until flaring of natural gas is halted. . . . Gas production is estimated at 280,000,000 cu. ft., with about 90,000,000 cu. ft. being flared in the field and another 130,000,000 cu. ft. vented at processing plants. . . . ¶Commission reveals it is planning to open Fort Chadbourne field in Coke and Runnels counties, Texas, this week. . . . The field has been shut in since February 1, 1952, for flaring of gas. . . . Lone Star Gas Co. now has completed new plant to process gas and maintain reservoir pressure in the field. . . .

ACTIVITY.—Production of crude and lease condensate averaged 6,495,750 bbl. daily for week ended March 21, up 44,100 bbl. daily. . . . ¶Total well completions for the week decreased 6 wells to 856. . . . Wildcat completions increased 12 wells to 203. . . . ¶Rotary rigs operating in United States on March 23 totaled 2,510 compared with 2,463 a week earlier. . . .

TRENDS.—The average number of rotary rigs in operation since the first of the year has been about 240 less than for the same period last year. . . . This is a drop of 8.8 per cent. . . . The average for North and West Texas this year has been 799 rigs compared with 1,040 for 1952. . . .

INTERNATIONAL.—American Independent Oil Co. gets significant strike in Saudi Arabia-Kuwait Neutral Zone after drilling five dry holes and spending an estimated $30,000,000 in the area since 1949. . . . Discovery well flowing 2,400 bbl. daily of 31°-gravity crude from first Burgan sand. . . . It had cut 150 ft. of saturated sand at the end of last week. . . . ¶Iranian Government turns down the sixth proposal made in the past 2 years for settlement of the oil-nationalization dispute in Iran. . . . Premier Mossadegh agrees to submit question to World Court arbitration, provided Britain asks only compensation for its physical properties. . . .

REFINING.—Further increase in capacity needed, even after completion of all current expansion projects, Tollett tells W.P.R.A. . . . Present capacity is greater than demand, but it is not at all great in view of possible needs in event of war. . . . ¶Fuel-oil markets for next 3 years will be good, Socony-Vacuum economists tell refiners at meeting. . . . Gas will capture more markets, but fuel oils also will gain, with coal the loser to the two. . . . ¶New light on octane requirements outlined before refiners as result of extensive experimentation by du Pont research technologists. . . .

PIPE LINES.—Sun Pipe Line to build 8-in. loop of its products line between Toledo and Inkster Junction near Detroit. . . . Line to cost $1,300,000 and carry 20,000 bbl. daily. . . . ¶Buckeye Pipe Line lets contract for last 291 miles of its new products line between Macungie, Pa., and Syracuse and Caledonia, N. Y. . . . Wilcox Trend Gathering System awards contract for 116 miles of 14 and 16-in. line and for 85 miles of laterals. . . .

GOVERNMENT.—New materials system to take the place of Controlled Materials Plan when CMP dies on July 1 outlined. . . . It won't provide for control of oil-country tubular goods. . . . ¶Interior Secretary McKay reportedly has cut $2,000,000 off budget for synthetic-fuels work. . . . Money will be saved by shutting down Bureau of Mines demonstration plant at Louisiana, Mo. . . .

DEEPEST WELL was drilled by this rig, shown on location in Weeks Island field.

CHRISTMAS TREE has been installed on the deep well. In the picture are F. P. McIntyre, left, division drilling foreman for Shell, and J. L. Milsted, drilling foreman on Rig 7.

Deepest Oil Field

Its special drilling problems have led to new techniques around Weeks Island dome, where deepest well was drilled

THE late completion of a 17,000-ft. oil well at Weeks Island, in Iberia Parish, coastal Louisiana, not only established a new world's deep producing record but has focused attention on a field in which development has been characterized by deep drilling and consistent and extensive production at great depths.

Although production has been found as shallow as 2,094 ft., most of the more than 100 wells which have been completed in the field produce from a succession of sands ranging in depths from 12,000 ft. to below 15,000 ft. Of the 10 wells in the country now producing from depths below 15,000 ft., 8 are in the Weeks Island field.

This development gives the field possibly the greatest concentration of deep production in the world, as well as the distinction of having the world's deepest single oil producer.

New record holder . . . The new 17,000-ft. well was drilled by Shell Oil Co., one of the three operating companies in the field. This well, 1 Weeks-Gall Unit, on preliminary test *(see The Oil and Gas Journal, March 23, page 161)* flowed 320 bbl. of 39.2°-gravity, pipeline oil with 8,281,000 cu. ft. of gas in 24 hours through 17/64-in. choke with 5,275 psi. pressure on the tubing. Gas-oil ratio figured 25,854 cu. ft. per barrel.

Total depth is given as 17,183 ft. with the actual oil-producing interval at 17,038-122 ft. in the open hole below 16,932 ft., where the last string of pipe was cemented.

Drilling of this well followed naturally the development of production in sands at successively lower levels. Production already had been found in a sand zone at 16,572-16,600 ft. in a well drilled by Shell Oil Co. late in 1951, but because of high gas-oil ratio operators had elected to plug back and complete the well in a higher sand with lower ratio in an interval at 15,296-336 ft. The latter well has been the deepest producer in the field until now, and until late last year was deepest producer in the state. It yielded the latter claim to a well completed by The

GETTING READY TO MOVE the big barge-mounted rig which drilled the world's deepest producing well. Crew members are transferring drill pipe from the pipe rack on Shell's Rig No. 7.

Texas Co. in the Bay St. Elaine field, in Terrebonne Parish.

Since the completion of the Shell record-breaking producer, an Humble Oil & Refining Co. well, 1 Hortense Gonsoulin, located only a half mile from the Shell well, also has passed the 17,000-ft. level, and at latest report was drilling and coring ahead below 17,130 ft., only 53 ft. short of the total depth of the latter.

Drilling program . . . Following specially adapted drilling procedures developed in other deep wells of the field, Shell experienced a minimum of trouble in putting down its new deepest well. The well, spudded October 9, 1952, and completed March 10, 1953, was drilled and completed in a relatively short over-all time of only 152 days with a net drilling time of 141 days.

Started with approximately 120 ft. of 16-in. conductor pipe in the initial 22-in. hole, it has 13⅜-in. surface casing cemented at 2,971 ft. Under the latter pipe, 12¼-in. hole was carried to 13,000 ft., where a protection string of 7⅝-in. casing was cemented, single stage, with 425 sacks of cement. Below this string, the hole is cased to 16,932 ft. with 7-in. liner sealed in the 7⅝-in. casing with top at 12,826 ft. Approximately 105 rock bits were used in making the hole.

The field . . . Weeks Island, located approximately 15 miles south of New Iberia in the coastal tidal marshes, is a shallow, piercement type salt dome, about 2 miles in diameter. It has been known as a salt dome since shortly after the Civil War, and has been mined commercially for salt since 1902, although first oil production was not found until 1945.

Production, in steeply dipping flanking sands, now extends around the north, northwest, west, south and southeast sides of the dome. The new deep well is on the north flank, where the most prolific and consistent production has been developed. Steady development has been carried on since oil was discovered with Shell, Humble, and Gulf Refining Co. as operators.

Present daily average production is more than 33,000 bbl. 1952 production totaled 10,700,000 bbl., and accumulated production has been approximately 30,000,000 bbl. Drilling is carried on with barge mounted rigs operated in natural or artificial waterways. The west side of the dome is in the open water of Weeks Bay.

Early wells, located relatively high and close to the dome, where formations are gouged, mineralized, and crystalized by the salt intrusion, presented many drilling difficulties because of hard drilling, key-seating, and twist-offs. Only a few were completed without fishing jobs. Steeply tilted formations complicated efforts to maintain straight holes.

Penetration rates often were only 12 to 15 ft. per day. In some wells, several thousand feet of salt overhang must be penetrated to reach producing sands. Average time to drill and complete wells in the gouge zone with average depth being around 12,400 ft., originally was around 200 days. Development of specially adapted practices and drilling muds has overcome most of these problems with the result that later wells in this class have been drilled in an average time of 148 days with costs reduced to an average of $350,000.

With extension of development to deeper sands away from the salt mass and the gouge area, these difficulties are not usually encountered with the result that these later deeper wells have been drilled and completed with a minimum of trouble with adjustments of drilling practices and mud treatment for their particular needs. Such wells, in the medium depth class (13,000 to 14,000 ft.) now are being drilled in an average time of 65 to 67 days at an average cost of around $200,000. Deeper wells to 15,000 ft. and below usually take from 200 to 220 days and cost up to $500,000 per well.

Relatively high bottom-hole temperatures (ranging from 285° F. to 300° F.) encountered in the deeper wells have presented a number of complications, particularly in mud treatment and in cementing of casing strings. Also, somewhat different casing programs are involved, adding to the drilling and completion time.

SOUTHWEST

Spraberry Shut In

Railroad Commission orders production halted on April 1 until facilities to process all produced gas are available

AUSTIN.—The huge Spraberry trend of West Texas last week was ordered shut in by the Texas Railroad Commission until the flaring of natural gas can be halted.

The commission order, announced by Chairman Ernest O. Thompson, said production in the big area "shall cease completely" effective April 1. The field shall remain closed, the order said, "until such time as the necessary facilities are made available for the gathering, processing, and marketing of all the gas from all the wells" in the field.

The Spraberry trend currently has an allowable of 149,644 bbl. daily, a little more than 5 per cent of the total Texas allowable for March. Natural-gas production has been estimated at about 280,000,000 cu. ft. per day, with 90,000,000 cu. ft. being flared in the field and another 130,000,000 vented at processing plants.

Thompson said the commission acted because of "undisputed evidence that the constituency of this gas and the volume . . . is such as to justify economically its saving."

Followed hearing . . . The order followed a show-cause hearing March 17 at which operators, with only one exception, urged the commission not to halt production, saying such an order would disrupt production, transportation, and marketing arrangements, would interrupt experiments aimed at finding ways to increase production in the reservoir, and might actually reduce the expected ultimate recovery of oil.

Thompson said, however, that testimony at the hearing showed that "there were approximately 3 gal. of liquid hydrocarbons per 1,000 cu. ft. of gas," not considering the value of the residue gas. This gas, he said, "should be and can be and must be diverted to lawful, useful purposes instead of being vented wastefully into the air.

In his statement, Thompson said: "The Railroad Commission of Texas has been warning the operators for many months that the waste of gas into the air in flares in this field was alarming and that such flagrant waste would not be tolerated . . .

"The law provides that no gas shall be permitted to escape into the air, and the commission is empowered to prevent, and has prevented, the waste of gas from gas wells, and the commission has very effectively and successfully been stopping the flaring of gas from oil wells by requiring that the oil not be produced until the gas that comes with the oil shall be saved and used for some lawful purpose."

At the show-cause hearing, operators testified that by the first of next year there would be gas-processing facilities more than ample to handle all gas produced in the field.

Fort Chadbourne to Open

AUSTIN.—The Texas Railroad Commission disclosed last week it is planning to open Fort Chadbourne field April 1. The field in Coke and Runnels counties, has been shut in since February 1, 1952, when the commission ordered production halted because of gas wastage.

The field is expected to be given 19 producing days for April with a daily allowable of 27,000 bbl. At the time the field was shut in, it had 229 producing wells with an aggregate allowable of 16,250 bbl. per day. It now has 290 producing wells.

The Railroad Commission's decision followed completion by Lone Star Gas Co. of a processing plant capable of handling 30,000,000 cu. ft. per day, extracting the liquids and boosting the gas to a pressure of 2,500 psi. for reinjection into the reservoir.

EXPLORATION

NEW OFFICERS of the A.A.P.G. who assumed their duties at the Houston meeting are, left to right, Elliott H. Powers, Southern Production Co., Fort Worth, secretary-treasurer; John Emery Adams, Standard Oil Co. of Texas, president; Leslie M. Clark, Pacific Petroleums, Ltd., Calgary, Alta., vice president; and A. J. Eardley, University of Utah, Salt Lake City, editor of the Bulletin.

Answers to Imports

They're here to stay, so cut costs and prices to meet the competition, Dunlop advises; voluntary cuts urged

Philip C. Ingalls

HOUSTON.—The oil industry of the United States must reduce its costs and prices if it is to meet the increasing imports of foreign oil without abandoning the competitive enterprise principles that have made this industry great.

That is what Robert G. Dunlop, president of Sun Oil Co., Philadelphia, told more than 3,000 members of the American Association of Petroleum Geologists, the Society of Exploration Geophysicists, and the Society of Economic Paleontologists and Mineralogists holding their annual meetings here last week.

Dunlop said that the domestic producer finds himself facing a wall of mounting imports of oil produced more cheaply than he can now match and that his situation is aggravated by the cutbacks in allowables, thus further increasing his unit costs and narrowing the return on his investment.

He said that continuation for a period of time of this situation inevitably will result in an impairment of both the economic incentive and the source of money needed for the drilling operations essential to effectuating the national defense program for oil producers.

One solution . . . Dunlop said that it would be much better if the importing companies would voluntarily reduce their imports. Governmental action through increased tariffs, quotas, or some other form of controls would be less desirable, he said. He said a voluntary course permits far greater flexibility to adjust the requirements of the situation and that it does not have the danger of continued government encroachment on the industry's affairs once national defense needs have been satisfied.

Dunlop pointed out that this solution must not be taken as any criticism of the operations of American companies abroad nor that he was suggesting that they cease operations. He said, however, that his thoughts were a plea that those companies temper their activities in order to promote the country's current national defense goals.

Actual challenge . . . Voluntary decreases in imports hardly can be regarded as any lasting solution of the problem of foreign oil, Dunlop said. "Realistically we must face up to the fact that so long as foreign oil can be produced and delivered here cheaper than domestic oil, we shall have to contend with imports," and, he said, "that is the challenge really facing the domestic producer."

It is possible, Dunlop said, that costs of producing and delivering foreign oil may increase or the risks inherent in foreign operation may offset the cost advantage, but it "would be imprudent to sit around twiddling our thumbs waiting for such eventualities to develop. The sure way to answer price competition is to reduce your own costs and prices."

Answering suggestions that it is impossible to reduce the costs of oil exploration and production, Dunlop said, "this industry again and again has reduced costs of transporting, refining, and marketing oil. It has developed methods and efficiences in those fields that a generation ago were called impossible to achieve."

He said that he had confidence that the ingenuity and resourcefulness of exploration and production men could do much more to lower costs and not only is there room for improved equipment and techniques, but the savings in operating costs possible through such arrangements as unitization hardly have begun. "We should make ourselves strong through efforts to do a better and less costly job," rather than seeking refuge under price umbrellas and artificial restraints.

Basis for idea . . . Dunlop led up to this challenge to the exploration and producing segments of the oil industry by pointing out that the American petroleum industry is stronger and more vigorous today in its service to the American people than it has ever before been in history. Though every aspect of our current situation is not as favorable as we might desire, he said, the American petroleum industry is in better shape now than it has ever been.

"Since World War II we have greatly increased the number, capacities, and perhaps even more important, the technical capabilities of our refineries. The industry is on the point of attaining its stated objective of increasing its refining capacity by a million barrels a day over the capacity that existed on January 1, 1951. At the same time our transportation system for oil has never been as fully adequate to do its job as it is today. We have more producing wells at present than ever before. We have, allowing for short-term variations, greater actual production. We have greater potential production with existing wells. And we have greater reserves of oil and gas in the ground.

"We have by no means as yet found all the oil that is to be found in this country. The best authorities think there is at least as much oil remaining to be discovered in this country as has already been produced in the entire 93-year history of the industry. Advances in pressure maintenance, fluid injection, and secondary recovery methods hold favorable promise for the future."

Dunlop said there were three major explanations for the vigor and strength of the oil industry in this country.

. . . Competition, the relentless, driving force that keeps each company doing its utmost to take the lead and hold it. Nothing is more stimulating or more likely to bring about that long run success of a business enterprise than the existence of other firms striving to produce similar goods and services at lower cost.

. . . Competency factor. The oil industry is made up of unusually competent and skillful people. The most competent and skillful oil men in the world are our fellow countrymen.

. . . Economic incentives. The existence of economic incentive determines the availability of a natural resource. In fact, the basic concept of a natural resource is the recognition that it is a manifestation of the resourcefulness of a free people. The test of the resource is its economic utility in the satisfaction of the wants and desires of the human race. This idea of availability as dependent upon economic conditions rather than on mere physical existence is fundamental in our domestic industry.

Growing problem . . . Domestic oil producers currently are facing a decline in economic incentive, Dunlop said, and they find themselves in a squeeze between rising production costs and an inability to get a higher price for their output. Thus, he said, the incentive and the wherewithal for drilling activities are being narrowed and already evidence appears of a slackening in the drilling pace domestic producers set last year. Current difficulties, he warned, are not merely the usual cause of recurrent maladjustments of supply and demand but the importation of foreign oil in substantial volume.

"Over the postwar years, oil imports have grown from relatively unimportant quantities to a volume averaging in excess of 1,000,000 bbl. a day so far this year. In the last 2 years the volume of imports has steadily increased, out of proportion to the increase in demand in this country." Imported oil has been supplanting domestic production, Dunlop said, and to such an extent that since last December the Texas regulatory authority has found it necessary to reduce allowable 380,000 bbl. a day.

Without laboring the well-recognized fact that oil is one of the most essential requirements of modern warfare, Dunlop said that until our national security is assured all else must be subordinated to the fulfillment of the oil industry's obligations in this regard. He said that in planning to meet these obligations we cannot assume that during a global war we shall have access to the oil resource of other nations, with the exception of Canada. He said we must base our preparations on the hypothesis that to wage a global war our country must be fully self-sufficient in the matter of oil supplies—"to do otherwise would be to trifle with our prospects of survival."

The answer . . . Provision for the immediate increase, when needed, of some 1,000,000 bbl. a day in production required for defense can be achieved only by an expanded drilling program in the absence of the unlikely prospect of a new flush discovery, but, Dunlop said, drilling programs cost money and only economic incentives in a free enterprise economy can provide that money.

However, he added, when costs go up without compensatory price increases, economic incentives are lessened, and then fears of a prolonged continuation of narrowing profit margins further weaken them. Dunlop blamed the increasing flow of imports into this country for the incentive decline and said, "The sure way to answer price competition is to reduce your own costs and prices. The competitive spirit of the industry will force us to do that and our competence and skill will give us the means. We but need the will to start taking steps in that direction."

The Presidents' Addresses

Beginning on page 165 are abridgements of the addresses of the retiring presidents of the three exploration societies presented at the joint annual meeting in Houston, March 24. These include addresses by Morgan J. Davis, American Association of Petroleum Geologists; Curtis H. Johnson, Society of Exploration Geophysicists; and C. C. Church, Society of Economic Paleontologists and Mineralogists. Abstracts of many of the papers presented begin on page 174.

S.E.G. Officers Installed

HOUSTON.—Roy L. Lay assumed the duties of the president of the Society of Exploration Geophysicists at the close of the society's annual meeting held here last week.

Lay, manager of The Texas Co.'s geophysical division, Houston, replaced Curtis H. Johnson as chief executive officer of this 3,300-member organization. Johnson, assistant chief geophysicist, General Petroleum Corp., Los Angeles, will continue to serve on the society's executive committee during the coming year.

R. L. LAY

K. DYK

B. W. SORGE

M. B. DOBRIN

S.E.G.'s new vice president is Karl Dyk, chief geophysicist, Stanolind Oil & Gas Co., Tulsa. Bart W. Sorge, vice president, United Geophysical Co., Pasadena, is the society's new secretary-treasurer.

Milton B. Dobrin will become the new editor of S.E.G.'s quarterly publication, "Geophysics," beginning next fall. Dobrin is senior research physicist, Magnolia Petroleum Co., Dallas.

INSPECTION TRIP through the new building followed dedication ceremonies at the Tulsa Chamber of Commerce. Here the group visits the new headquarters. Shaking hands at left are Past Presidents Morgan Davis and Frank Morgan.

AT THE ROSTRUM during ceremonies dedicating the new A.A.P.G. building is E. DeGolyer, past president of A.A.P.G. and the Sidney Powers medalist in 1950, who accepted the building on behalf of the association's founders. At right is Frank Morgan, past president, who presented the building to the founders.

Building Dedicated

Geologists formally open first permanent quarters of A.A.P.G.; Association's growth, responsibility outlined

Philp C. Ingalls

TULSA.—The first permanent quarters of the American Association of Petroleum Geologists was dedicated here March 20.

The building, now in final stages of completion, was inspected by members of the Tulsa Geological Society and distinguished guests from many parts of the country following a special luncheon meeting at the Tulsa Chamber of Commerce building.

Morgan J. Davis, president of the A.A.P.G., conducted the luncheon meeting and introduced the two speakers, Frank A. Morgan and E. DeGolyer, and other prominent A.A.P.G. figures.

Morgan, immediate past president of the A.A.P.G. and the man who initiated the plan of building a permanent office building for the association, presented the building to E. DeGolyer, representing the founders of the A.A.P.G.

Big job ahead . . . In his address Morgan said that the A.A.P.G. ". . . has done much toward the advancement of the geological science. This fine new building will do much to bind together the accomplishments of the past and it will be the permanent home for the works of the future."

Morgan said that although much has been done in petroleum geology it is clear that much remains to be done and that much will be done in the future.

"The job is becoming bigger, the responsibility greater. At present we seem to be in a period in which geologists, the members of our association, are carrying an increasing part of the load, the over-all responsibility of the oil and gas business."

He said that all of these things suggest that petroleum geology is now becoming of mature age and that "the construction of this permanent building at this time seems particularly fitting as a marker of this milestone and fitting as a monument to the achievements of the past and a foundation for the future."

History recalled . . . E. DeGolyer, past president (1925-26), honorary member (1944), and Sidney Powers medalist (1950) of the A.A.P.G., accepted the building for the founders of the A.A.P.G. DeGolyer told of the preliminary meeting of geologists at Norman, Okla., and of the founding of the association 36 years ago in Kendall Hall of Kendall College (now the University of Tulsa) under the name of the Southwest Association of Petroleum Geologists.

He spoke of the growth of the membership from 85 registrants in 1918, when the association's name was changed to the American Association of Petroleum Geologists, to the more than 10,000 membership today.

BUILDING COMMITTEE of the A.A.P.G. shown during dedication ceremonies includes, left to right, Roscoe E. Shutt, Tulsa consultant; William J. Sherry, Tulsa; Frank Clark, Tulsa consultant and committee chairman; A. I. Levorsen, Tulsa consultant; and John G. Bartram, Stanolind Oil & Gas Co.

Present at the dedication luncheon were 15 of the 90 living founders of the A.A.P.G. The complete list of founders, geologists who participated in the 1915-17 meetings, carries 125 names which are honored by a bronze plaque in the entrance hall of the new headquarters building. Those in attendance at the luncheon meeting were: William F. Absher, F. L. Aurin, John G. Bartram, Walter R. Berger, Ed Blosch, Charles E. Decker, E. DeGolyer, James H. Gardner, J. V. Howell, Richard Hughes, Jerry B. Newby, Charles H. Row, J. M. Sands, Charles H. Taylor, and Lucian Walker.

Lahee Honored

Sun official receives top geology award at meeting

HOUSTON.—Frederic H. Lahee, geological and research counselor of Sun Oil Co., Dallas, was presented the Sidney Powers Memorial Medal here last week by A. I. Levorsen of Tulsa, representing the American Association of Petroleum Geologists.

The gold medal, highest honor awarded in petroleum geology went to Lahee for his "outstanding achievements in and continuing contributions to the field of petroleum geology as an educator, author, skilled administrator and executive, and as a pioneer in gathering and use of hydrocarbon reserve and exploration data."

This highest honor in petroleum geology is named in honor of the late Sidney Powers of Tulsa, fourteenth president of the A.A.P.G. Only six other geologists have received this coveted gold medal: Wallace E. Pratt, 1945; Alexander Deussen, 1947; A. I. Levorsen, 1948; E. DeGolyer, 1950; the late Max Steineke, 1951; and K. C. Heald, 1952.

Lahee was president of the A.A.P.G. in 1932 and was elected an honorary member in 1947 in recognition of his outstanding contributions to the association.

President's award . . . Donald F. Towse, associate professor of geology, University of North Dakota at Grand Forks, received the President's Award at the annual convention from Morgan J. Davis, retiring president of the A.A.P.G.

D. F. TOWSE

T. KREY

This award, consisting of a certificate and $100 cash is given annually to the author under 35 years of age whose article in the A.A.P.G. monthly bulletin of the preceding year is judged by the medal-award committee as the most significant contribution to petroleum geology.

SIDNEY POWERS AWARD is being presented here to Dr. Frederic Lahee, left, by Morgan Davis, outgoing president of the A.A.P.G.

Towse's winning article is entitled "Frontier Formation, Southwest Powder River Basin, Wyoming," a condensation of a dissertation presented in partial fulfillment of requirements for the Doctor of Philosophy degree at Massachusetts Institute of Technology.

Honorary members . . . Alexander Deussen and Harry R. Johnson were awarded honorary memberships in the A.A.P.G. Presentations of the gold cards were made by W. E. Wrather and Homer J. Steiny.

Deussen, consulting geologist, Houston, was one of the founders of the A.A.P.G. and served as its second president during 1918-19.

Johnson, consulting geologist, Los Angeles, is a past president of the Pacific Coast section of the A.A.P.G.

Honorary memberships in the A.A.P. G., presented for distinguished service to petroleum geology, are held by only 18 living geologists.

S.E.G. award . . . Theodor Krey, Seismos G.m.b.H., Hannover, Germany, was recipient of S.E.G.'s fifth annual best-paper award.

Krey's paper, "The Significance of Diffraction in the Investigation of Faults," was voted by the society's committee on honors and awards to be the most outstanding contribution published in Geophysics, S.E.G.'s quarterly publication, during 1952. Presentation of the certificate was made by Curtis H. Johnson, retiring president of S.E.G.

New S.E.P.M. Officers

HOUSTON.—The incoming officers of the Society of Economic Paleontologists and Mineralogists included Harold N. Fisk, chief of geologic research section, Humble Oil & Refining Co., and Samuel P. Ellison, Jr., Department of Geology, University of Texas at Austin.

H. N. FISK

S. P. ELLISON, JR.

Fisk was elected vice president and Ellison, secretary-treasurer. The president-elect, J. Marvin Weller, University of Chicago, now on assignment in the Philippines, submitted his resignation prior to the Houston meeting.

S.E.P.M. members voted here to approve an amendment to the society's by-laws permitting Fisk to be advanced to the presidency.

ROCKY MOUNTAIN

Service Gets Steel for Line

BISMARCK.—Service Pipe Line Co. is expected to begin construction during the second quarter on its crude-oil line from the Beaver Lodge-Tioga area to Mandan.

The line will serve the 30,000-bbl. refinery now under construction at Mandan by Standard Oil Co. (Ind.). Completion of the refinery is scheduled for early 1954.

Service already has been allocated 19,314 tons of line pipe, plate and structural steel for the project by the Petroleum Administration for Defense. The 170-mile line will be 12 and 16-in. in diameter and will have an initial capacity of 35,000 bbl. daily and an ultimate capacity of 162,000 bbl. daily. Completion has been scheduled tentatively for the first quarter of next year.

The crude line and the refinery will provide an outlet for the increasing production, now largely shut in, in Tioga and Beaver Lodge fields. At present production averages only about 10,000 to 12,000 bbl. daily. Only crude-oil movement out of the fields is by tank car, and daily production is determined by tank-car availability.

16 PAGES OF OIL MAPS PAGE 103 **Don't miss the bonus feature in this issue—16 full-page, full-color map section showing the principal oil and gas areas of the United States. Maps are of a size to permit fullest usefulness and convenience.**

MID-CONTINENT

COMPLETED AND DEDICATED is Vickers new derrick-type T.C.C. unit.

Packaged Cracker

T.C.C. unit dedicated by Vickers at Potwin, Kans.

John C. Reidel

POTWIN, Kans.—Vickers Petroleum Co. dedicated its "packaged" derrick-type T.C.C. unit March 20.

This is the second packaged T.C.C. unit to be installed, the first having been constructed for New Mexico Asphalt & Refining Co. at Artesia, N. M. *(The Oil and Gas Journal, January 21, 1952, page 92).*

The Potwin unit has a nominal fresh-feed capacity of 4,000 bbl. per stream day, plus 2,500 bbl. per day of recycle, operating at 75 per cent conversion level. In place of the conventional structure which supports the cat cracker vessels, a derrick-type structure is used. By erecting this derrick before units are installed, it can be used for rigging operations. In this manner, the expense of assembling and dismantling heavy rigging equipment at the job site can be avoided and rigging costs kept at a minimum. *(For more detail on unit see The Oil and Gas Journal, March 16, page 120).*

New facilities . . . The new Vickers facilities include feed preparation, cat cracking section, fractionation, gas plant, and catalytic polymerization units. Engineering was by Southwestern Engineering Co. Initial costs were held to a minimum by use of shop fabrication, standardization of flow sheets, preengineering of a large part of the plant, and use of a standard plot plan which can be modified to some extent for particular conditions.

Following dedication of the new facilities, Jack A. Vickers, Jr., president of Vickers Petroleum, presented a silver plaque to Southwestern Engineering's president, Robert P. Miller, at a dedication dinner in recognition of completion of the new facilities in less time and at less cost than first was estimated.

Analysis by Tracers

Radioactive isotopes speed process experiments in lab

RADIOACTIVE tracers such as Carbon-14 expedite experimental laboratory work for the refining process engineer, Dr. James O. Maloney, head of the department of chemical engineering, University of Kansas, told members of the Tulsa section of the American Chemical Society recently.

Carbon-14, in the form of organic materials, permits extremely rapid analysis of performance data and an improvement in the degree of accuracy in the study of diffusional operations such as distillation and extraction, Dr. Maloney said.

Tracer studies find particular application in the determination of the effect of operating variables such as boil-up rate and reflux ratios on the laboratory performance of a distillation column. The minimum reflux ratio can be determined experimentally by this method, Maloney said.

Carbon-14 was selected from five carbon isotopes for tracer studies. Carbon-10, 11, and 14 are radioactive, but, of these isotopes, Maloney said, Carbon-14 is the only one suitable for tracer work. Carbon-14 exhibits a half-life of 5,728 years as compared to the 8-second half-life of Carbon-10, and the 23-minute half-life of Carbon-11. Carbon-12 and 13 are stable.

Instrumentation hurdle . . . One major hurdle that had to be conquered in the radioactive-tracer studies was instrumentation, he said. Ordinary Geiger counter tubes were found to be unsuitable for measurement of the low level of Beta electrons emitted by Carbon-14. After a long period of experimentation, a special chamber was invented that would collect properly the radioactivity of volatile liquid samples for measurement.

The solution containing the radioactive liquid is first placed on the window of the Geiger counter using a hypodermic syringe. The tube is then connected to a continuous-flow sample meter used with a rate meter and a continuous recorder. A continuous recorder is necessary because radioactive materials disintegrate at a random rate, and measurements must consider the magnitude of the "background" radiations due to cosmic rays and other sources.

A.P.I. Citations Presented

TULSA.—Four citations for service and two gifts of appreciation were presented by the Mid-Continent District of the Division of Production, American Petroleum Institute at its spring meeting here March 18-20.

Receiving citations were: W. K. Whiteford, Gulf Oil Corp., Pittsburgh, district chairman in 1931 and secretary-treasurer in 1928; C. D. Watson, Carter Oil Co., Tulsa, district chairman in 1928; Glenn M. Stearns, British-American Oil Producing Co., Dallas; and Henry C. Miller, Globe Oil & Refining Co. Wichita, chairman of general arrangements for 1952, district vice chairman from 1939 through 1941, and district secretary-treasurer in 1938.

Carl A. Young, director of the production division, was presented with a silver urn in appreciation of his 27 years of service to the A.P.I. Young will retire effective July 1.

C. P. Dimmitt, Phillips Petroleum Co., Bartlesville, Okla., the retiring vice president in charge of production, was given a brief case in recognition of his years of work on standardization for the A.P.I.

CORROSION of oil and gas well equipment is the province of N.A.C.E.'s Committee TP-1, biggest and one of the most active of the association's technical committees. Sessions of the group at the Chicago meeting attracted more than 100 members and guests. At the speakers' table at right are H. L. Bilhartz, Atlantic Refining Co., Dallas, outgoing committee chairman, at left, and R. C. Buchan, Humble Oil & Refining Co., Houston, new chairman.

Sweet-Well Corrosion

Chemical inhibitors offer cheapest preventive, N.A.C.E. told; 30 per cent of sweet wells "economically affected"

Gerald L. Farrar

CHICAGO.—About 30 per cent of the country's low-pressure sweet oil wells are "economically affected" by water-dependent corrosion, H. E. Greenwell, of Atlantic Refining Co., declared here last week.

This means, he said, that each has an annual cost of corrosion of $200 or more. Actually, he said, speaking in an oil and gas production symposium at the annual meeting March 16-20 of the National Association of Corrosion Engineers, the average annual cost of corrosion in these wells is $960 per well.

The meeting was attended by about 1,600 corrosion engineers. More than a quarter of a million dollars worth of corrosion-prevention equipment was displayed by some 90 exhibitors.

The average low-pressure corrosive well experiences 11 years of relatively trouble-free operation before corrosion sets in. After corrosion starts, tubing life is reduced to an average of 3 years, and may be as low as 6 months, Greenwell said.

Low-pressure, water-dependent corrosion of sweet oil wells should not be confused with water-independent corrosion which occurs at high pressures, usually from the beginning of the well's production history, Greenwell emphasized.

Relationship to water production . . . Only a small proportion of low-pressure wells producing less than 40 bbl. of water per day are corrosive, while 75 per cent of those making greater than 100 bbl. of water per day are corrosive. However, there is no direct correlation between volume of water produced and corrosion. Distribution of wells between these limits of water production into corrosive and noncorrosive categories is random, Greenwell said.

HIGHEST RECOGNITION in the field of corrosion engineering, the F. N. Speller award, is shown here being presented to Scott P. Ewing, left, by N. E. Berry, at the annual N.A.C.E. meeting. The award is given for outstanding achievement in corrosion engineering. Ewing is associated with Carter Oil Co., Tulsa. Berry, an N.A.C.E. past president, is with Servel, Inc., Evansville, Ind.

The water-oil ratio has a primary influence on whether a given well in a corrosion-susceptible field is corrosive. Data taken on a number of corrosive fields show there is a critical water-oil ratio below which corrosion does not occur. This ratio is approximately 40 per cent for most fields, he said.

Apparently the wetting tendency of the oil is reduced to the point that an oil film no longer adheres to the metal wall, thus permitting water containing causative agents to come into direct contact with the metal, he said.

Corrosion-susceptible field . . . Corrosion tendency in a field may be traced to presence of naturally occurring carbon dioxide and fatty acids. Carbon dioxide causes severe pitting attack and is usually considered the primary cause of corrosion. Rate of reaction does not decrease with time, since no insoluble primary corrosion products are formed, Greenwell said.

Corrosion in a sweet oil well can be anticipated by observing the action of gas wells in the same field. The corrosion tendency of the reservoir is disclosed early in the life of gas wells. The oil wells become susceptible when the oil no longer affords protection to the steel. Once the critical water-oil ratio is reached in production, corrosion can be expected, if the gas wells are corrosive, he said.

Preventive measures . . . Chemical inhibitors constitute the most widely employed preventive measure. One operator treats a large group of wells by batch injecting inhibitor into the gas-lift system, Greenwell said.

Stick-type inhibitors have been used successfully in a large number of wells. In general, stick treatment appears to be more expensive than application of liquids, he said.

The percentage of water at which the water-oil ratio becomes critical may be increased by adding a wetting agent to increase the wetting power of the oil. However, specialized equipment and procedures must be employed, and usually many agents must be tried in any given well, Grenwell added.

Casing failures . . . Casing failures in oil and gas wells in 22 United States

OLD AND NEW presidents of the N.A.C.E. are shown here at the association's annual banquet, with the new vice president. Left to right are M. G. Fontana, Ohio State University, Columbus, retiring president; Walter F. Rogers, Gulf Oil Corp., Houston, new president; and Aaron Wachter, Shell Development Co., Emeryville, Calif., new vice president.

fields during the years 1949 through 1951 may be estimated to be about 650, with repair costs of approximately $6,600,000. While these figures cannot safely be extended to include all the several thousand United States fields, the magnitude of the problem is nevertheless evident, according to Jack L. Battle of Humble Oil & Refining Co.

The installation of insulating flanges to isolate the well-head and subsurface equipment from the flow line to eliminate surface stray currents has been effective in many fields. Further, he said:

. . . **The setting of packers** and the loading of the annulus with alkaline fresh-water muds or nonvolatile inhibitors in crude oil is widely practiced.

. . . **Results from 225 wells** in a West Texas field and wells in several East Texas fields indicate that cathodic protection can be obtained to a depth of 6,500 ft. at current densities of 0.03 ma. per square foot.

. . . **The corrosive characteristics** of fields should be evaluated early in order that suitable mud and cementing programs can be adopted for future drilling.

. . . **All recovered subsurface equipment** should be examined thoroughly for corrosion, and complete descriptions and cost data should be kept on damaged equipment.

. . . **The use of perforated tubing,** couplings, and orifice buttons as means of protection should be eliminated in every instance possible.

Protection Is Profit

Dow is saving $5 for each $1 spent at its Freeport, Tex., plant on cathodic units for heat exchangers, condensers

CHICAGO.—Cathodic protection for heat exchangers and condensers using sea water or brackish water as cooling medium results in savings of greater than $5.00 for every $1.00 expenditure, Burke Douglas, Dow Chemical Co., said here at the annual meeting of the National Association of Corrosion Engineers.

More than a quarter of a million dollars is saved annually at Dow's Freeport, Tex., plant, as the result of a cathodic-protection program, Douglas said.

Accelerated corrosion . . . All of the heat exchangers and condensers at the Freeport plant are subject to either severe pitting of steel, selective galvanic corrosion of various materials of construction, graphitization of cast iron, or combinations of these attacks. This situation results from a combination of the factors: low-electrolyte resistivity, high water velocity, comparatively high water temperature, and turbulence of the water, he said.

Anode installation . . . Mitigation of corrosion in this equipment has been accomplished using a magnesium-anode installation which is bolted tight against the surface to be protected. Corrosion has been reduced to an insignificant amount for the life of the anode, he said.

First tests showed the anode life to be very short. This condition was remedied by increasing the anode-to-cathode circuit resistance. This solution was feasible since the area to be protected in most heat exchangers is small and does not require the maximum current output of the anode to achieve protection, Douglas said.

In order to insert the additional ¼-ohm resistance required into the electrical circuit of the bolt-on anode without mechanically weakening the installation, a resistor washer was fabricated. By properly insulating the anode, all current delivered by it is forced to flow across this washer which is bolted to the anode, he said.

The standard system, consisting of anode and washer, is fabricated into a single compact unit weighing 15 lb. It is small enough to fit into most exchangers. When required, two or more units can be installed to give additional protection, Douglas said.

Anode units have been installed in approximately 350 heat exchangers and condensers, varying in size from 1 to 14 ft. in diameter.

Economics of protection . . . Economics of the protection program show savings of more than $5.00 for every $1.00 invested, considering only the corrosion costs for steel and cast-iron head replacement. If the factors of tube and tube-sheet damage, lost product, lower operating efficiency, safety hazards, and the cost of power lost as a result of turbine condenser failures are considered, even greater savings accrue, he said.

Corrosion Faults

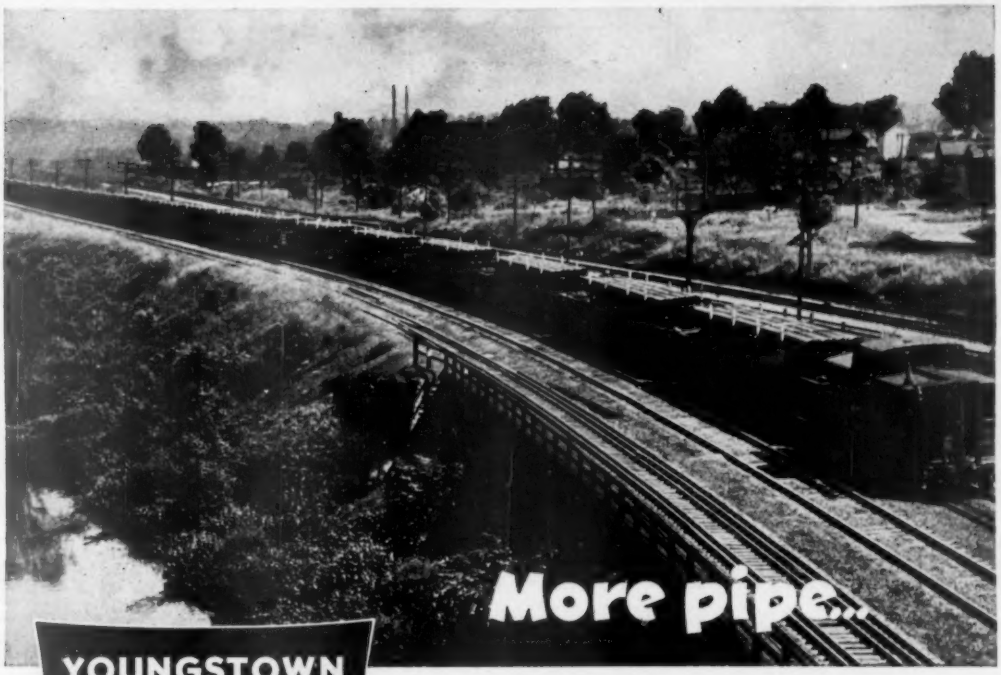
Cathode-system designers often miss vital factors

CHICAGO.—Engineers frequently disregard one or both of the critical factors in designing cathodic-protection cable connections for pipe-line systems, according to Ray M. Wainwright of the University of Illinois electrical-engineering department.

Speaking during the cathodic-protection symposium at the annual meeting of the National Association of Corrosion Engineers, Wainwright said these factors are environmental requirements having to do with insulation and preparation of the wires and cables, and conformance to Kelvin's economic law.

Environmental requirements . . . Insulation material for underground lines should be neoprene or neoprene and rubber combinations, he said. The problem is one of chemical stability during long periods of exposure to moisture and soils. Indefinite maintenance of good insulating characteristics is mandatory.

On positive underground cables (attached to positive terminal of the rectifier), all splices and underground terminals must be carefully insulated and absolutely water tight. The smallest pinhole in the insulation will create an anodic area on the cable, resulting



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Model D leveling "Oil Pad" at site of newly completed well near Snyder, Texas—just one of dozens of maintenance jobs.

in rapid corrosion of the cable metal, Wainwright said.

Even asphaltic compounds have been found inadequate for sealing unless carefully applied. In order to prevent subsequent corrosion it is also essential to obtain a bond between the tarry compounds and the sheath material of the cable. The use of the newer plastic tapes shows promise for this application, he said.

Care should also be taken with insulating the negative cables. While they receive cathodic protection from the system, these cables are located near the ground bed, resulting in high voltage with respect to the surrounding soil. Current leakage can be appreciable; leakage currents up to 25 per cent of the rectifier output have been noted, he said.

Kelvin's economic law . . . This law states that the proper cable size is one which makes the sum of the annual cost of the losses and the annual fixed charges a minimum, Wainwright said.

Annual cost of losses should be computed as a function of current, power cost, cable resistance, and rectifier efficiency. Annual fixed charges on the cable should be computed as a function of cable length and initial cost of cable per unit length. These are added to give total costs. Total costs should then be computed for different sizes of cable. The proper cable size is determined at the point of lowest total cost, Wainwright concluded.

PARTICIPANTS in the opening technical session of the W.P.R.A. meeting in San Antonio last week were, left to right: L. A. McReynolds, Phillips Petroleum Co., Bartlesville, who presided; J. J. Mikita of E. I. du Pont de Nemours & Co., Wilmington, who co-authored a paper on "Combustion Chamber Deposits and Their Effects on Engine Fuel Requirements"; and W. D. Thomas, Jr., American Cyanamid Co., New York, who reviewed "Application of Lubricating Oil Additives".

Fuel-Oil Outlook

Demand should continue to increase for next 3 years but at more moderate rate, Socony economists tell W.P.R.A.

George Weber

SAN ANTONIO.—The outlook for fuel-oil markets during the next 3 years is good. Despite the continued upsurge in potential gas sales, fuel-oil demand should continue to increase through 1955, although the increase will be moderate by comparison with the past 3 years.

These conclusions were presented last week to the Western Petroleum Refiners Association by Albert J. McIntosh, chief economist, and James A. Coble, research assistant, Socony-Vacuum Oil Co., Inc., New York. Assuming that natural gas will probably continue to capture additional fuel markets, they believe that fuel oils will maintain a lower rate of increase, and that the brunt of this stiff competition will be borne by coal.

As McIntosh and Coble see it, consumption of distillate fuel oils including No. 1 range oil, will reach 1,500,000 bbl. daily this year and 1,665,000 bbl. per day by 1955. Dieselization of railroads will account for an estimated rise from 209,000 bbl. per day this year to 250,000 bbl. per day in 1955's diesel-fuel demand. Heating oils will see daily average demand rise from 787,000 bbl. this year to 927,000 bbl. in 1955. Exports will continue to decline, from an estimated 75,000 to 27,000 bbl. per day over the same period.

The over-all consumption rate for residual oils, they said, will remain essentially static during the next 3 years. The East Coast states should show a fairly large increase, while other districts are expected to show no significant increase or a slight decrease. A continuing loss in exports will offset much of the domestic gain in residual demand. The authors' estimates on residual consumption indicate that total uses in 1953 will reach 1,654,000 bbl. per day in 1953, up 59,000 bbl. from 1952, and by 1955 they will have increased moderately to 1,663,000 bbl. per day.

Big gas gain . . . On the basis of a recent report by the Petroleum Administration for Defense, 45 per cent more gas will be sold in 1955 than in 1951 and 66 per cent more than in 1950. Translating these increases into barrels a day, the additional gas sold in 1955 over 1950 is equivalent to 1,300,000 bbl. of oil per day. This is just about the equivalent of all distillates consumed in the United States in 1952, including all home heating and diesel uses, as well as the rest of the distillates which various users consume, the authors reported.

Lube-oil additives . . . The substantial increase in additive content of lubricating oils since 1945 was outlined by W. D. Thomas of American Cyanamid Co., who detailed the characteristics and functions of the seven types of additives: pour depressants, viscosity-index improvers, antioxidants, bearing-corrosion inhibitors, detergents, anti-foam agents, and rust preventives.

The trend toward more efficient engines with higher compression ratios will continue and will be accompanied by more severe lubrication requirements, Thomas said.

"Of our present-day problems, cold-weather sludge arising from start and stop operation is foremost. A means of evaluating oils in the laboratory for this service would greatly accelerate the development of more-efficient, lower-cost additives. In regard to the problem of combustion-zone deposits, we cannot preclude the possibility of its solution by the use of the proper lubricant, but at present it appears that the selection of the base oil will be more important than the additives."

Pollution control . . . R. N. Giles of Standard Oil Co. (Ind.), chairman of the A.P.I. committee on Disposal of Refinery Wastes, reviewed the technical and political trends which are affecting the disposal of refinery wastes.

Stronger abatement measures for water and air pollution appears inevitable, he reported, warning that severe con-

sequences would possibly result from a passive attitude by industry toward solution of these problems.

Refining Capacity

There is no big excess, Tollett informs W.P.R.A.

SAN ANTONIO. — Present refining capacity is in excess of domestic demand, but there is no great excess of efficient capacity, according to R. L. Tollett, president of Cosden Petroleum Corp. and retiring president of the Western Petroleum Refiners Association.

Speaking before the W.P.R.A. meeting here last week, Tollett said "every expansion project now under way should be completed, and even further expansion encouraged." Considering the less economic facilities, he said, capacity is not at all too great in view of the possible needs in event of war.

Heavy fuel . . . "To say that fuel-oil prices are depressed to levels economically unsound is almost an understatement when it refers to the markets available to our rail-shipping members," Tollett said.

"Present net backs on shipments of distillate fuels are less than their values as cracking stocks. The prevailing market for No. 6 oil is less than many of us pay for fuel gas of equivalent fuel value. How long this situation will continue will depend upon how long the gasoline markets remain reasonably firm. Gasoline inventories are at very high levels. Natural gasoline prices have declined sharply over the past 3 months. If we should get a sharp break in motor-gasoline prices, many of our members would be hard pressed, indeed.

"Let us not complain too much about present market prices for burning oils. Our fuels move principally in competition with coal. This is especially true with respect to residual oils. It may be that we are now getting all that the consumers can pay. We may be experiencing a realistic change in refinery economics. So long as there is left to us a reasonable spread between delivered cost of crude oil and the realization on our products, we may be in a situation that will be regarded as normal in the future."

Imports not excessive . . . Denying any authority on the subject of imports, Tollett stated his personal opinion that crude-oil imports do not appear to be material with respect to the high level of domestic production. His conclusions are based, he stated, on a study of readily available statistics showing what crudes are imported and where, rather than on press releases and public statements, most of which he believes are self-serving and slanted.

A great portion of the imports appear to be residual fuel oils that meet a demand for which there is no domestic competition except from the coal industry, he said. Further, some imported crudes have almost singular characteristics which make them always in short supply. A considerable volume of imported crudes are going to refineries which are purposely built and especially adapted for refining foreign oil.

W.P.R.A. Elects Officers

SAN ANTONIO.—Roland V. Rodman, president of Anderson-Prichard Oil Corp. and Col-Tex Refining Co., Oklahoma City, was elected president of the Western Petroleum Refiners Association at its forty-first annual meeting here last week.

He succeeds R. L. Tollett, president of Cosden Petroleum Corp., Big Spring, Tex., who served two terms as head of the association.

W. J. Carthaus, vice president of Deep Rock Oil Corp., Tulsa, and Reid Brazell, president of Leonard Refineries, Inc., Alma, Mich., were newly elected vice presidents. Reelected as vice presidents were H. J. Kennedy, vice president of Continental Oil Co., Houston, and J. W. Vaiden, vice president of Skelly Oil Co., Tulsa.

New directors elected to the board include: H. W. Manley of Sunray Oil Corp., Tulsa; F. L. Martin of Suntide Oil Corp., Corpus Christi; John W. Newton, vice president of Magnolia Petroleum Co., Beaumont, Tex.; and Walter Famariss, Jr., of Famariss Oil & Refining Co., Hobbs, N. M.

Octane Buildup

Tests measuring directly the effect of thermal insulation of engine deposits on octane needs, described to W.P.R.A.

SAN ANTONIO.—Further light was shed last week on the effects of both fuels and lubricants on combustion-chamber deposits and octane-requirements increases during the opening technical session of the Western Petroleum Association meeting here.

Reporting on research by E. I. du Pont de Nemours & Co., Inc., J. J. Mikita and W. E. Bettoney verified the findings of other investigators regarding the formation of carbonaceous and lead salt deposits and the attainment of deposit equilibrium.

They obtained a direct measurement of the effect of thermal insulation on octane requirement, one of several factors involving such deposits. Unleaded fuel deposits, they found, are almost as poor conductors of heat as asbestos. By coating the cylinder head with various thicknesses of Teflon, a polytetrafluoroethylene resin, they demonstrated the effect of thermal insulation. A clean single-cylinder engine, coated with 0.006 in. of Teflon, they found, increased the octane requirements of the engine 10 units.

The authors further confirmed the important effect of deposit particles on preignition by injecting particles into the combustion chamber of a car on the road. Before deposit injection, only an occasional preignition was observed during repeated accelerations from 10 to 60 miles per hour with a 70-octane-number primary-reference fuel and basic spark setting of 20° after top dead center.

However, the injection of one gram of either leaded or unleaded fuel deposits caused a number of preignitions to occur during the acceleration. While neither pure lead compounded nor pure carbon particles caused appreciable preignition, combinations of the two were noted to be very active.

Clean fuel important . . . Some fairly startling findings were reported regarding the effects of clean versus dirty fuels and conventional versus synthetic lubes on octane-requirement buildup in clean engines.

In one series of laboratory tests, run under low-duty cyclic conditions, wide variations in the increase in octane requirements were noted. A catalytically cracked fuel with 3 ml. of TEL, when used with a Mid-Continent high-detergency lube, registered an 18 octane-number increase. The same fuel-lube combination without lead showed an increase of 16 units. Cat cracked fuel, leaded with 3 ml. when used with a synthetic ester lube reduced the octane requirement increase to 13. Isooctane with 3 ml. of TEL and ester lube brought the increase down to two units, and the same combination without lead, to less than one. These laboratory findings were essentially duplicated in light-duty road tests.

Mikita and Bettoney also demonstrated that preignition, for some cars, is a more important problem than knock. From the road tests, they conclude that the already formidable prob-

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lem of preventing knock is to be further compounded by the problem of preventing surface ignition.

CANADA

Gas-Purchase Pact Signed

CALGARY, Alta. — Trans-Canada Pipelines, Ltd., and Canada Southern Oils, Ltd., have negotiated the first major contract for sale of western Canadian gas for shipment to eastern Canadian markets.

Trans-Canada, a subsidiary of Canadian Delhi Oil, Ltd., has agreed to pay initially 8 cents per M.c.f. for daily production estimated roughly to be about 50,000,000 cu. ft. in the Coleville-Driver area of southwestern Saskatchewan. Canada Southern is the principal producer in the area.

Gas would be supplied the proposed line to Ontario and Quebec, on the basis of 1 million cubic feet daily for every 10 billion cubic feet of proved reserves. The Saskatchewan government estimates proved reserves in this area at 500 billion cubic feet. Conditional permission to export gas has just been granted by the province.

The purchase contract contains provision for renegotiation every 5 years and for adjustment of the price per M.c.f. on a sliding scale tied to the price being paid other producers in the area.

Gas Export Approved

REGINA, Sask.—Saskatchewan has decided to export its gas.

It will do so, however, only if certain conditions are met. J. H. Brockelbank, provincial resources minister, said export would be permitted if the transmission company desiring to export gas would guarantee a supply of gas at reasonable rates sufficient to meet the province's needs and insure an adequate share of Canada's total export market for natural gas produced in Saskatchewan.

If these terms are not accepted, the province will permit export only after reserves of 1 trillion cubic feet have been proved, Brockelbank said. It then would allow export of 50 per cent of proved reserves over 1 trillion cubic feet and 75 per cent of proved reserves over 3 trillion cubic feet.

Saskatchewan also would have the right to restrict export in the event provincial reserves were reduced by export and if it were determined that allowable production set by the oil and gas conservation board for any one year were insufficient to meet provincial demand.

Brockelbank said proved and unproved reserves in the province now are estimated at about 1 trillion cubic feet. A recent engineering study estimated the province's foreseeable requirements for the next 20 years could be met with proved reserves of between 700 and 800 billion cubic feet.

Imperial Hikes Crude Price

CALGARY.—Imperial Oil, Ltd., has announced increases of 6 cents a barrel in prices posted for crude from fields in Alberta.

The new higher prices will bring Alberta crude, delivered at Sarnia in line with comparable crudes from the United States. Imported crudes at Sarnia are higher because of the increasing exchange value of the United States dollar.

New postings for some of the important fields are: Leduc-Woodbend, $2.485; Redwater, $2.385; Joseph Lake, $2.38; Golden Spike, Armisie, and Acheson-Stony Plain, $2.425.

Imperial also announced higher product prices in British Columbia due to higher prices paid for crude following the increases in crude prices in California.

At Vancouver, gasoline prices are up 1.7 cents a gallon, furnace oils gained 2.1 cents, and stove oil increased 2.4 cents.

Industry Briefs

OTTAWA. — Interprovincial Pipe Line Co. has obtained permission of the Canadian Board of Transport Commissioners here to lay a 6-mile crude line from the International boundary near Sarnia, Ont., to serve Sarnia refineries. The line will connect at the boundary with the extended system Interprovincial is now laying from Superior, Wis.

AUSTIN.—A bill has been introduced in the Texas Legislature here by Rep. Henry G. Lehman, Giddings, providing a minimum price of 15 cents per M.c.f. for gas at the well head. Lehman contends the sale of gas for less than 15 cents adversely affects the welfare of royalty owners, producers, landowners, and state taxing authorities.

NEW YORK. — Esso Standard Oil Co. has revealed that it will make monthly reports of its imports of crude oil and residual fuel. Stanley C. Hope, president, said the action is being taken in response to recent widespread and growing interest in the volume of imports and to requests that importing companies make public such figures.

BATON ROUGE. — The upward trend in Louisiana crude-oil-production allowables was arrested last week when the state conservation commission trimmed the allowable for April to 683,592 bbl. daily. This is a cut of 26,252 bbl. daily from the allowable production for March. The monthly allowables had climbed steadily since August 1952.

AUSTIN.—The Texas Railroad Commission will begin hearings next week on what is believed to be the first project to store ammonia underground. The commission will rule on an application by Phillips Chemical Co., a subsidiary of Phillips Petroleum Co., to drill wells to store ammonia into cavities washed out of salt beds at 1,500-2,500 ft. underlying the firm's Cactus plant, in Moore County in the Texas Panhandle.

OKLAHOMA CITY.—The Oklahoma Corporation Commission last week reduced the state's April crude-oil allowable 20,645 bbl. daily to 519,260 bbl. daily—the first time the commission has cut production allowables in about a year. Representatives of some of the crude-purchasing companies said the cut isn't big enough in view of the generally increasing crude and products stocks in the nation.

OKLAHOMA CITY.—The Oklahoma House of Representatives refused last week to accept a bill with a Senate amendment providing for a 1-cent per M.c.f. severance tax on natural gas at the well head.

BAKERSFIELD, Calif. — The deep test Ohio Oil Co. is drilling, as unit operator, at Paloma field is now below 17,732 ft., making it the second deepest well ever drilled in California. Scheduled possibly to go below 20,000 ft., drilling of 72-4 K.C.L. has been under way since October 1951. Record California deep well is Superior Oil Co. 1 Limoneira in Ventura County, abandoned at 18,734 ft. in 1949.

LOS ANGELES.—Preliminary seismic exploration in waters offshore from San Diego has been started by a three-company group comprised of Standard Oil Co. of California, General Petroleum Corp., and Humble Oil & Refining Co. Western Geophysical Co. will do the work, which will extend from Oceanside south to the Mexican border.

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New Materials Plan

Successor to CMP would contain no controls over tubular goods for oil-field use; present plan to expire July 1

Bertram F. Linz

WASHINGTON.—Basic rules for operation of the new Defense Materials System which will supersede the Controlled Materials Plan July 1, if Congress approves, were unveiled last week by the Office of Defense Mobilization.

No provision is made in the new system for any control of oil-country tubular goods.

DMS Regulation 1 cancels unused allotment authority for civilian controlled materials for the third and subsequent quarters and removes preferential status from civilian orders already accepted for delivery after June 30 except where orders have been accepted for shipment prior to July 1 and are carried over into the third quarter.

The first effect of the new orders will be to permit producers of materials now controlled to accept unrated orders for delivery of steel, copper, and aluminum after June 30.

What is planned . . . Under the projected DMS the Defense Department and Atomic Energy Commission will provide a statement of the quantities of steel, copper, and aluminum needed each quarter to meet their production and construction programs for defense. Producers of the metals will be told what their share of this defense requirement will be and will be required to reserve a portion of their total production for defense orders in accordance with National Production Authority directives.

Tentative plans for reorganization of the Office of Defense Mobilization as the over-all defense agency after June 30 call for consolidation of defense functions and will include a special program planning and study group to handle the problems of industrial expansion.

The revamped ODM will handle all questions of defense production, stabilization, manpower, materials and stockpiling, but will be so organized that in the event of war these activities could be separated and expanded as much as necessary.

Final details of the plan have not been worked out, but it is believed to provide that the Petroleum Administration for Defense and certain other temporary agencies will remain in the departments to which they are now attached.

PAD approval needed . . . Deputy PAD Administrator J. Ed Warren said that with 3 months still to go under CMP, operators will have to get PAD approval of construction projects if they wish to begin construction during the second quarter, even though they may have all materials for the project on hand.

PAD also will continue to process requests for approval of projects where construction is scheduled to start during the second quarter, regardless of whether materials will be required during that period, and also will process requests for priorities assistance on line pipe required during the quarter.

All reporting requirements now in effect will continue to apply until June 30, he emphasized.

Synthetics Deemphasized

WASHINGTON.—The Interior Department is preparing to abandon its effort to prove that synthetic liquid fuels can be produced at costs competitive with natural petroleum, it was reported this week.

Interior Secretary Douglas McKay, it is understood, has cut the $7,000,000-plus appropriation carried in the Truman budget for synthetic liquid fuels work by $2,000,000, stipulating that the reduction shall be applied in the demonstration work carried on by the Bureau of Mines at Louisiana, Mo.

This reduction, it was said at the department, will halt all operations at the demonstration plant.

The bureau will continue its basic research and the pilot-plant operations now under way.

No decision has yet been reached as to what will be done with the plant.

Lignite Gasification Studied

WASHINGTON.—Bureau of Mines chemists and engineers are doing extensive research on the gasification of lignite in North Dakota which produces synthesis gas and hydrogen usable for the production of synthetic liquid fuels and chemicals.

There is no present intention, however, of starting any synthetic-fuels development in the area. Bureau scientists frankly concede that despite the low cost of lignite and a bountiful supply of water, neither liquid-fuel nor chemical production could be developed economically.

Research on the gasification of lignite with steam was begun by the bureau in 1943. Interest has continued because large reserves suggested an important potential raw material from which synthesis gas and hydrogen could be used for synthetics.

The bureau plans to continue the work with a view to developing an efficient process for gasification, said now to be far from perfect. Practical use of lignite gas, however, is seen as depending upon developments in the oil, natural gas, and power industries.

Experiments at the bureau's pilot plant at Grand Forks have given gas yields ranging from 36,000 to 54,000 cu. ft. per ton. Lignite, however, has only about 60 per cent as much carbon content as eastern coals.

EASTERN

A.P.I. Eastern Meeting Set

PITTSBURGH.—The spring meeting of the eastern district of the American Petroleum Institute Division of Production will be held in the William Penn Hotel here April 8-10.

Speakers at the opening general session April 9 will include: William Penn Snyder, chairman, Allegheny Conference on Community Development, Pittsburgh; John G. Pew, vice president, Sun Oil Co., Philadelphia; and J. Ed Warren, deputy administrator, Petroleum Administration for Defense.

The following technical papers are scheduled tentatively:

"The Intensive Analysis of Oil-Filled Cores," J. C. Calhoun, Jr., C. R. Killins, and F. W. Preston, Pennsylvania State College; "Selective Plugging of Gas-Injection Wells with Smoke on a Secondary Oil Recovery Project," Paul T. Bail, U. S. Bureau of Mines, Bradford, Pa.; "Conditioning of Engine Exhaust Gas for Injection Into Oil Reservoirs," J. N. Breston, and R. C. Neal, Pennsylvania Grade Crude Oil Association, Bradford, Pa., and Henry Bohne and James C. Waterman, Thornton Co., Wellsville, N. Y.; "Discussion of Oil and Gas Well Shooting in the Appalachian Area," R. L. Bird, Jr., Columbian Carbon Co., Charleston, W. Va.

"Paleozoic Geography as Related to Petroleum Accumulation in West Virginia Geologic and Economic Survey"; "Preparation of Wells for Underground Storage of Gas," Underground Storage Subcommittee of the Eastern District Study Committee on Natural Gas Operating Practices, J. G. Montgomery, Jr., chairman; "Proper Well Completion for Chemical and Hydraulic Treatments," D. M. Roberson and H. F. Coil, Dowell, Incorpo-

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rated; "Hydrafrac Application to Oil and Gas Production in the Eastern Area," Bob Diggs Brown, Halliburton Oil Well Cementing Co., Flora, Ill.; "Rotary Drilling Costs in the Leidy and Driftwood Gas Fields," John W. Hendrickson, New York Stock Natural Gas Corp., Pittsburgh; "Appalachian Rotary Drilling: Present and Past," Byron M. Finch, Pipe Line Construction & Drilling Co., Pikesville, Ky.; and "Educating the Supervisor," Carl B. Brunt, Jones & Laughlin Steel Co., Pittsburgh.

Sun to Loop Products Line

PHILADELPHIA.—Sun Pipe Line Co., a subsidiary of Sun Oil Co., has announced plans for construction of 45-mile, 8-in. products-line loop between Toledo and Inkster Junction, Mich., west of Detroit.

The $1,300,000 line will have a capacity of about 20,000 bbl. daily. Construction is scheduled to start about the middle of May, and the line is slated to be in operation by October 1.

The new line will parallel an existing Sun line from Toledo to Sarnia, Ont., where the company is now erecting a $14,000,000 refinery, also scheduled for completion in October. The new line will deliver products from Toledo to the company's marketing terminal at River Rouge, Mich. This will permit conversion of the existing line, which now moves these products, to carry crude to the new Sarnia refinery.

Sun will lay twin 8-in. lines under the Maumee River in Toledo to insure continuous service.

Buckeye Contracts Awarded

NEW YORK.—Buckeye Pipe Line Co. has let contract for construction of the remaining 291 miles of its new products line between Macungie, Pa., and Syracuse and Caledonia, N. Y.

Bills Construction Co., Tulsa, has already started laying 8½ miles of 14-in. from Macungie to Guthsville, Pa., and 8½ miles of 8-in. from Guthsville to Allentown.

Pipe Line Construction & Drilling Co., Camp Hill, Pa., will lay 52 miles of 14-in. line from Guthsville to Dupont, Pa.

Fulghum Contracting Corp., Camp Hill, was awarded contract for 51½ miles of 14-in. from Dupont north to the Pennsylvania-New York state line.

Williams-Austin Co., Pittsburgh, has 75 miles of 14-in. from the Pennsylvania-New York state line to Auburn, N. Y., and 27 miles of 10-in. from Auburn to Syracuse. Contract for 69 miles of 10-in. from Auburn to Caledonia was let to Universal Map & Survey Co., Fond de Lac, Wis.

Clearing of right-of-way will start this week on those sections where work is not already in progress. Completion of the entire line is scheduled for about the middle of September.

WATCHING WASHINGTON

Bertram F. Linz

PAD May Remain

A good case is being made for continuation of the Petroleum Administration for Defense, in its present autonomous form but slimmed down, after June 30.

There are growing indications that the administration will not scrap the emergency mobilization organization but will keep a good part of it, both to deal with defense programs not yet completed and as a hedge against the needs of another sudden international crisis.

The price, wage, and material controls now passing out of the picture were only segments of the mobilization program set up after the red invasion of Korea. They received the most public attention but in the long run industry expansion and other parts of the program were equally or more important.

So far as PAD is concerned there are a half-dozen fields in which continued effort is believed necessary. They include the aviation-gasoline problem, aid to the military in getting other products, review of applications for certificates for accelerated amortization of new facilities, assistance to the industry in dealing with materials problems which it is foreseen may arise, the compilation of statistics needed by the military and other agencies, programming of future expansion, and what little planning for plant dispersion may be found practicable in the industry.

Alaskan Leasing?

With the Navy pulling out of Alaskan exploration a move is on foot to open up some 48,000,000 acres adjoining Naval Petroleum Reserve No. 4 to private oil search.

Lifting of the ban on private exploration imposed in 1943 has been asked of Interior Secretary Douglas McKay by E. L. Bartlett, Alaskan delegate to Congress.

The 48,000,000 acres, together with areas in the Alaskan peninsula and the Katalla - Yakataga regions since released, were closed to private operations "in connection with the prosecution of the war" shortly before the Navy started on its $45,000,000 search for oil in the naval reserve.

In view of the fact that a multimillion dollar program for wildcatting and development in the Katalla-Yakataga region is now getting under way, Bartlett believes that if the reserved area were released private interests would quickly undertake to see what it contains in the way of oil.

Imports Free-for-All?

The residual-import situation appears to be building up to where it may explode in an industry free-for-all.

Already the jobber-distributors on the Atlantic seaboard who favor increased imports have charged the independent refiners with seeking "selfish goals" in their demands for limitations and that latter have retorted that the jobbers are showing "short-sighted industrial statesmanship." The independent producers are on the same side as the refiners, and the jobbers are supporting the importing companies.

A congressional investigation may well result, and the House Commerce Committee already is digging into the matter.

The refiners assert that the impact of imports is felt most seriously in the interior. Foreign oil entering Atlantic ports does not too greatly affect East Coast refineries but does back up normal tanker shipments of residual from the Gulf Coast. Gulf refiners faced with the necessity of shutting down, materially reducing crude runs, or finding new markets take advantage of low-cost river transportation to shift their product into the north-central area, where Mid-Continent refiners have to absorb tank-car freight rates to the markets as an alternative to shutting down.

The consequent low price then becomes the published price in the Rocky Mountain area, where refiners must meet it to sell to the railroads, which constitute 90 per cent of their market, or shut down. Already one company is shut down and three other independents reportedly plan to do so in the next few weeks if there is no change in the market.

Consequently, the refiners contend, if the importing companies do not voluntarily curtail the movement of foreign oil only a government-imposed quota on residual imports will save the industry from becoming demoralized.

Crude Output Drops

Lower production in United States and Venezuela reduces world total, but Middle East fields set all-time record

FREE World production of crude oil was down approximately 66,500 bbl. daily in January as a result of lower output in the United States and Venezuela.

Production in the Middle East, on the other hand, rose to a new all-time high. Fields in Iraq turned out a record volume of oil during the month, while Kuwait for the second time in its history went above the 800,000-bbl.-daily mark.

Production throughout the Free World, which excludes Russia and its Communist satellites, averaged approximately 11,642,200 bbl. daily during January. United States production in January amounted to an estimated 6,500,000 bbl. daily, a decline of nearly 134,000 bbl. daily, or 2 per cent, from the all-time record in December of 6,633,700 bbl. daily. Non-Communist foreign production showed a net increase of 67,200 bbl. daily, or 1.3 per cent.

Total Free World production in January was some 755,000 bbl. daily or 7 per cent over January 1952. The largest part of this 12-month increase has come in production abroad which was up 471,700 bbl. daily, or 10.1 per cent, during the period. United States production in January was 283,500 bbl. daily above the corresponding month of 1952, for a percentage gain of 4.6 per cent.

Total world production, including the estimated output of Russia and eastern Europe, is now approaching 13 million barrels daily. Available information indicates that crude production in the Soviet Union itself is running in excess of a million barrels daily.

Venezuela . . . Venezuelan production in January dropped 68,900 bbl. daily, or 3.7 per cent, to 1,792,100 bbl. daily. Venezuelan output began rising last September following a summer slump and by December had reached a new all-time high of 1,861,000 bbl. daily. The principal Venezuelan producers were reported to have cut back the output of the heavy crude fields in the Lake Maracaibo region. This reflects the soft market for heavy fuel oils in the United States.

Canada . . . Canadian production was holding up better than anticipated during the winter months when navigation is closed on the Great Lakes and shipments through the Interprovincial line are curtailed. Canadian output will probably rise to about 300,000 bbl. daily later this year following initial operation of the new Trans Mountain line to the Pacific Northwest.

Production in Trinidad, which has been virtually stationary since the end of the war, has shown slight increases in recent months to reach 60,000 bbl. daily. Argentina's production also has climbed, presumably as a result of new-field development by the government oil administration.

In western Europe, Italy's small crude production reached 2,000 bbl. daily, the result of a succession of small increases over the last year. Most of this crude is coming from Cortemaggiore field where the government company finished a gasoline plant last summer. Crude production in western Germany was down by about 200 bbl. daily in January.

Middle East . . . The 2,252,300 bbl. daily production in the Middle East in January exceeded the previous record of last June by 44,400 bbl. daily.

TREND OVER THE LAST YEAR

	Western Hemisphere less U. S.	Middle East	Total foreign less Russia and satellites
February	2,438.8	1,860.1	4,692.0
March	2,437.8	1,996.5	4,813.8
April	2,459.6	2,090.8	4,933.2
May	2,527.6	2,142.1	5,059.9
June	2,517.8	2,208.9	5,117.6
July	2,495.0	2,126.1	5,018.7
August	2,425.5	2,091.7	4,921.7
September	2,417.8	2,168.2	4,994.8
October	2,455.8	2,175.1	5,047.2
November	2,504.9	2,174.7	5,098.7
December	2,561.3	2,092.1	5,075.0
January	2,462.6	2,252.3	5,142.2

WORLD CRUDE-OIL PRODUCTION
(In thousand of barrels daily)

Country—	Jan. 1953	Dec. 1952	Jan. 1952
W. Hemisphere:			
Argentina	74.0	73.8	68.0
Bolivia	1.3	1.3	1.5
Brazil	2.3	2.2	1.4
Canada	157.0	187.5	128.1
Chile	2.9	3.2	2.2
Colombia	107.2	104.0	107.4
Cuba	0.1	0.1	0.1
Ecuador	7.8	8.0	7.7
Mexico	212.9	215.8	222.5
Peru	45.0	44.4	44.2
Trinidad	60.0	60.0	56.4
Venezuela	1,792.1	1,861.0	1,811.7
Total	2,462.6	2,561.3	2,451.2
Europe and Africa:			
Algeria	1.2	1.2	0.4
French Morocco	2.1	2.1	1.9
France	6.5	6.4	6.9
W. Germany	37.4	37.6	29.1
Italy	2.0	1.9	0.8
Netherlands	13.1	12.3	13.8
Egypt	46.5	46.4	45.5
United Kingdom	1.1	1.1	1.0
Total	109.9	109.0	99.4
Middle East:			
Bahrein	30.1	30.0	30.1
Iran	23.0	23.0	30.5
Iraq	533.2	514.3	187.0
Kuwait	806.6	710.2	674.1
Qatar	78.0	81.2	57.7
Saudi Arabia	780.9	732.8	853.7
Turkey	0.5	0.6	0.5
Total	2,252.3	2,092.1	1,833.6
Other Asia:			
British Borneo	104.0	97.2	104.8
Burma	2.5	2.5	2.2
India	6.0	6.0	5.0
Indonesia	190.0	192.0	160.8
Japan	5.6	5.6	5.7
New Guinea	4.8	4.9	4.8
Pakistan	4.5	4.4	3.0
Total	317.4	312.6	286.3
Total foreign	5,142.2	5,075.0	4,670.5
United States	6,500.0	6,633.7	6,216.5
Total, Free World (excluding Communist controlled areas)	11,642.2	11,708.7	10,887.0
Estimated Russia and Satellite Countries:			
Austria	60.0	60.0	50.0
Rumania	80.0	80.0	80.0
Russia	1,010.0	1,010.0	900.0
Other Communist	25.0	25.0	28.0
Total	1,175.0	1,175.0	1,058.0
World Total	12,817.2	12,883.7	11,945.0

Figures are from reliable reports in the industry or official government sources. Data for Russia and Eastern Europe are based on competent estimates; no authentic information is available on month-to-month production in these areas. Completely current reports also are lacking for certain countries of Southeast Asia. Data for earlier months have been revised where necessary.

Other Communist areas comprise China, Czechoslovakia, Hungary, Poland, and Yugoslavia.

The largest part of the record high production in the Middle East was contributed by Kuwait. The month's average of 806,600 bbl. daily was about 96,400 bbl. daily above December production of 710,200 bbl. daily. The record high in Kuwait was last July when production amounted to 810,200 bbl. daily.

Iraq's record production in January resulted from the latest of the increases which have occurred during the last year from the completion of the Kirkuk-Banias 30 and 32-in. pipe line. The January total for the country was 7,200 bbl. daily over the previous high of 526,000 bbl. daily last October. Of the January total, 436,700 bbl. daily came from Kirkuk field, 57,200 bbl. daily from Zubair in southern Iraq, 28,300 bbl. daily from Ain Zalah field, which went into commercial production only last October, and the remainder from Anglo-Iranian's Khanaqin field near the Iranian border.

Arabian American Oil Co.'s production in Saudi Arabia rose more than 48,000 bbl. daily in January over the previous month. The month's output, however, was 72,800 bbl. daily below January 1952, a time when the Saudi Arabian fields were being called on to assist in meeting the deficit resulting from the Iranian loss.

MIDDLE EAST

Neutral Zone Strike

American Independent wildcat flows 2,400 bbl. daily in Burgan sand test; well cuts 150 ft. of pay, still coring

A SIGNIFICANT strike in the Saudi Arabia-Kuwait Neutral Zone was reported last week by American Independent Oil Co.

The company tested 2,400 bbl. daily of 31°-gravity crude after penetrating the top of the first Burgan sand in its Wafra 4, a wildcat in the west-central portion of the Neutral Zone. The first Burgan was found at 3,470 ft.

For American Independent, it was the first indicated commercial production after having drilled five dry holes and spent an estimated $30,000,000 since beginning operations in the Middle East in 1949.

The 2,400-bbl. production rate was determined by a drill-stem test using a 1-in. bottom-hole choke and 1-in. top-hole choke, a company official said. After the test the company continued coring and at the end of last week had cut more than 150 ft. of saturated sand. Plans were to continue coring either to the bottom of the sand or to oil-water contact.

The discovery well is located about 20 miles from the Kuwait border and about 25 miles from the coast. In previous tests the company had not found the Burgan sand oil bearing.

Earlier flow . . . Earlier the company had reported production of 19½°-gravity oil at a rate of about 500 bbl. daily from an undetermined zone up the hole. With surface pipe set at 600 ft. and 9⅝-in. casing cemented at 3,000 ft., the heavy crude began flowing through the annular space between the two, forcing its way through the packer, a company spokesman said. An electric log indicated this production was from about 1,700 ft., which would make it the first production found in the Middle East from a formation younger than the Burgan sand, he said.

The Wafra 4 is on a structure indicated by a seismic survey to be about 4 miles wide and 7 or 8 long. If the geology is like that of Kuwait's nearby Burgan field, four producing formations can be expected to be found. In Burgan field the first Burgan sand, while productive, is not produced, oil being taken from the third sand. In this area there are three well-defined oil sands and one productive limestone formation. Production in Burgan is about 5,000 to 6,000 bbl. per well daily.

An American Independent official said the Wafra well, originally planned to penetrate the Arab zone at 8,000 to 9,000 ft., probably will be completed in the first Burgan sand.

The neutral zone is a wedged-shaped piece of territory along the Persian Gulf between Kuwait and Saudi Arabia. Its land area is about 2,500 sq. miles. It is virtually uninhabited desert ruled jointly by the Saudi Arabian Government and the shaikh of Kuwait. It was long regarded as one of the Middle East's hottest prospects, especially since Kuwait's Burgan field is a short distance across the northern border.

The concession . . . The concessions for each undivided half interest in the zone was obtained in 1948, by American Independent Oil Co. (now one-third owned by Phillips) from Kuwait and by Pacific Western Oil Co. from Saudi Arabia. The high prices and unusually favorable terms given for these concessions were a surprise to the industry at the time. However, they now seem not particularly unusual in view of the much higher royalties and profit-sharing deals that have since been agreed to elsewhere in the Middle East.

For the Kuwait concession, Aminoil agreed to a 34-cent a barrel royalty plus a $7,250,000 bonus and the gift of an expensive yacht. The shaikh has a 15 per cent interest in the operation and receives a $625,000 yearly payment. Pacific Western agreed to a 55-cent a barrel royalty, paid a $9,500,000 bonus, and a $1,000,000 guaranteed annual payment. It obligated itself to build a 12,000-bbl. daily refinery when production reaches 75,000 bbl. daily. The government would have a 20 per

Guests of the New York Nomads

Foreign and domestic visitors at the meeting of the New York Chapter of Nomads early this month included: (left to right, top row) Ed Christianson, Shell Oil Co., Houston; Walter Butler, Conselho Nacional de Petroleos, Brazil; Paulo Castro Silva, Conselho Nacional de Petroleos, Brazil; Roy L. Boydston, Martin-Decker Corp., Long Beach, Calif.; Paulo Oliveira Castro, Conselho Nacional de Petroleos, Brazil; A. Fritsch, Raffineries Francaises de l'Atlantique, France; W. C. Hatfield, Texas Petroleum Co., Colombia; (bottom row) Peter Wardlaw, Shell Oil Co., Houston; Fernando Riberio, Conselho Nacional de Petroleos, Brazil; Travis Coggan, Iraq Petroleum Co., Iraq; L. E. Courteau, Gulf Oil Corp., Barbados, B.W.I.; and Earl Fuller, Val Wittich, Indonesia.

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TEXAS

cent interest in the plant. The profits for the government in both refining and producing would be calculated before taxes.

Background . . . Aminoil took over the exploration under an agreement between the two concession holders in June 1949. James MacPherson, formerly general manager for Arabian American Oil Co. in Saudi Arabi, was placed in charge as vice president, and headquarters set up in Kuwait. Then followed a series of disappointments.

Five wells were drilled from December 1949 to June 1952, and all were nonproductive. After the first four the company carried out additional seismograph work, but the fifth well, located on the coast, was also dry at 7,429 ft. last June

On one prominent structural feature, a well drilled by the company found an absence of cap rock and recovered dead oil. It was reported last year that altogether, some $30,000,000 had been spent in the so-far unsuccessful operation.

Early this year, the two concession-holding companies agreed to continue the program with two more wells, one in the central part of the zone and the other in the southwest. Santa Fe was given a contract to drill these holes.

It is this first of the two additional wells that is now reported to have found production.

Iran Rejects Sixth Offer

The Iranian Government last week turned down the sixth settlement proposal that has been made in the 2 years since it took over the properties of Anglo-Iranian Oil Co., Ltd.

Latest offer to be rejected was that which had been put forward February 20 on behalf of the British by Loy W. Henderson, U. S. ambassador in Teheran. In a 90-minute radio address March 20, Iranian Prime Minister Mossadegh lashed out at "foreign machinations" in reviewing the history of the oil-nationalization dispute.

However, Dr. Mossadegh did not slam the door entirely to further negotiations. He said Iran would agree to World Court arbitration of the compensation issue, provided Britain consents to a basis acceptable to Iran. What Dr. Mossadegh is demanding is that Britain give up any claim for compensation for the 42-year unexpired period of the concession contract and accept payment only for its physical facilities. At the same time, Iran would submit a number of counterclaims for back taxes, unpaid customs duties, etc.

EUROPE

Sicilian Search Warms Up

A rig is scheduled to be shipped from Houston the latter part of this month for Sicily where it will be used for the first test by the Gulf organization on its concession acreage.

Location for the initial well has been made on the edge of the town of Ragusa in the southeastern part of the island near long-known oil seeps. The concession is held by American International Fuel & Petroleum Co., a Gulf subsidiary.

A second exploratory well is scheduled for later this year on a concession originally granted to MacMillan Petroleum Corp. This concession has since been transferred to Mediterranean Oil Co., a joint Gulf-MacMillan company. Seismograph and core drilling is being carried out on the Mediterranean Oil acreage in conformity with concession obligations.

Anglo - Iranian Oil Co., Ltd., announced in London that geological and gravity-meter surveys by D'Arcy Exploration Co., its subsidiary, will be finished in mid-March on its Sicilian concession. The company was granted rights in areas around Ravanusa, Vittoria, and Priolo in southern and eastern Sicily in June 1951. Results of the survey work will be studied before any decision is reached on drilling.

LATIN AMERICA

Depth Records Set

New drilling depth records have been established in wildcat operations in Venezuela and Colombia.

In western Venezuela, the well LS-1387 of Venezuela Oil Concessions, Ltd. (Shell), has reached 17,190 ft. to become the deepest hole ever drilled outside the United States. The well last week was coring at this depth.

This test, which is investigating Cretaceous possibilities in the area, is located 12 miles south of Lagunillas in the State of Zulia. The company crew has 7-in. casing set at around 16,400 ft.

Previous Venezuelan depth record was held by Alturitas 1 west of Lake Maracaibo. This Creole Petroleum Corp. well went to 17,087 ft. before it was completed September 15, 1950, in the upper formations. Creole's Alturitas 2, about 3½ miles southeast of No. 1, is drilling below 16,180 ft.

Shell's previous deepest well was Curazao 2A drilled shortly after the war in the Cabimas area of Lake Maracaibo. This test was drilled by an all-Venezuelan crew to below 16,000 ft.

In Colombia, the Arroya Grande wildcat of International Petroleum Co. of Colombia, located on the Caribbean Coast, at last reports was below 12,091 ft. At this depth, the well became the deepest ever drilled in that country. In the long history of oil exploration in Colombia, only five wells have gone below 11,000 ft. and none previously below 12,000 ft. International is reported to have had shows in the Eocene at about 8,500 ft.

Caracas-to-I.P.E. Express

Special express-plane service from Caracas, Venezuela, to Tulsa during the International Petroleum Exposition will be provided under sponsorship of Petroleo Interamericano, the bilingual Latin American oil magazine published by The Oil and Gas Journal.

Arrangements have been completed for the special express service with Chicago & Southern Airlines. Latin American oil men arriving via the special planes will be met at the airport by Oklahoma dignitaries and exposition officials.

International Briefs

Engineers and technicians at the Abington laboratories of Esso Development Co., Ltd., in England have built up by synthesis a lubricant said to meet the exacting requirements of turbo-prop and turbo-jet engines. Reports from London are that the initial work carried out in Britain led to developments along the same lines as in the United States, and quantities of the components used in manufacture of the new lubricant are now being exported to the United States.

The Sainte Juliette 1 wildcat of Soc. Nord Africaine des Petroles in east-central Tunisia has been drilled to 12,053 ft. and testing has been started at around 10,250 ft. The company is 65 per cent owned by Gulf with the remaining interest held by the government-controlled SEREPT. Another Tunisian wildcat is that being drilled at Ktitir southwest of Sousse by Cie. des Petroles de Tunisia (Shell). Unconfirmed reports are that this well has obtained shows in Cretaceous horizons.

Texas Gulf Producing Co.'s interest in Ganso Azul Cia. de Petroleo, which carries on a small integrated operation east of the Andes in Peru, was incorrectly carried as 6 per cent in an article in the March 23 issue of The Oil and Gas Journal. Texas Gulf Producing Co. actually has a 60 per cent interest in the company.

PERSONALS

Gulf Coast Expert

Michel Halbouty is widely known Houston consultant

MICHEL T. HALBOUTY, Houston consulting geologist and petroleum engineer, is an authority on the geology of the Texas Gulf Coast and Louisiana. He is rated as one of the top experts on the geology of Gulf Coast salt domes.

Halbouty, 43, is best known outside the petroleum world as the coauthor of the recent book "Spindletop." He owns and operates production in Spindletop field.

He is a native of Beaumont, Tex., and received bachelor of science and master's degrees from Texas A. & M. College. He joined Yount-Lee Oil Co. as a junior geologist in 1931 and was chief geologist and petroleum engineer when the company interests were sold to Stanolind Oil & Gas Co. in 1935.

For 2 years he was vice president and general manager for Glenn McCarthy Interests, Houston. He then entered business as a consultant.

Before being called to active duty as an Army infantry captain in 1942 he was geologically responsible for discovery of the following oil fields and structures:

West Beaumont, North Cotton Lake and Palacious oil fields; northwest extension to Lafitte field; and production in the east flank of Jennings salt dome. Acadia Parish, Louisiana; southeast flank of High Island salt dome, Galveston, Tex.; east flank of Starks salt dome, Calcasieu Parish, Louisiana; and northwest flank of Starks salt dome and Cedar Bayou fault structure, Chambers County, Texas.

At the time of his detachment from the Army in September 1945 he was a lieutenant colonel serving as chief of the petroleum production section, Planning Division, Army-Navy Petroleum Board. Since leaving the service he has been geologically responsible for new production in the following:

Hull, Sour Lake, South Liberty, Spindletop, Saratoga, Lytle, North Blue Ridge, Boling, Pine Island and Ashland oil fields, and the north extension of Englehart gas field and northwest extension of Esperson dome.

John L. Oliver, a trainee for Ohio Oil Co. at Hobbs, N. M., has been promoted to petroleum engineer at Seminole, Tex.

H. M. Houghton, formerly in the geophysical department of Amerada Petroleum Corp., has joined Geophysical Prospecting Co. of Canada, Ltd., Calgary, as a director and general manager.

Dr. Richard L. Sawyer has been promoted to supervisor of the fuels-development research department at the Beacon, N. Y., laboratories of The Texas Co. He has been with Texaco since 1938 and before his promotion was an assistant to the assistant director of research.

Lawrence W. Lee has been named executive vice president and general manager for Husky Oil & Refining, Ltd., Canadian subsidiary of Husky Oil Co., Cody, Wyo. He also has been elected to the company board of directors. Prior to assuming his new post Lee was vice president and manager of refining and sales for the parent firm. He had been on leave of absence for 1½ years while serving as director of marketing and distribution for the Petroleum Administration for Defense in Washington, D. C.

Wayne Dean, Gulf Coast division superintendent for the drilling department, Kerr-McGee Oil Industries, Inc., has been promoted to general superintendent of the company's drilling department. He will move his headquarters on April 1 from Morgan City, La., to Oklahoma City. **W. F. Baxter,** who has been Dean's assistant, has been named to replace him. **M. C. Womack** will succeed Baxter. **George B. Kitchel,** general superintendent of the drilling department, has been promoted to department manager.

James N. Garrison has been appointed special-projects engineer for the petroleum refinery division of Arthur G. McKee & Co., Cleveland, engineers and contractors. Prior to his appointment he served as chief engineer in this division. **James C. Baird** has been promoted from assistant chief engineer to succeed Garrison.

Olen Lane has been promoted from assistant regional general manager for Continental Oil Co. to regional general manager at Los Angeles. He succeeds **C. R. Allen,** who is retiring because of ill health.

Donald G. Wildes, engineer for Republic Natural Gas Co., has been transferred from Dallas to Corpus Christi.

Fenton H. Finn, president of New York State Natural Gas Corp., Pittsburgh, has been elected a director of Consolidated Natural Gas Co., the parent firm. He has been with the Consolidated System companies since 1932 and has served as chief geologist and vice president of New York State Natural. He also has been a director of the subsidiary company since 1951.

Leo J. Gude, formerly general superintendent for Oil Development Co. of Texas and Coline Oil Corp. at Amarillo, Tex., is now a consulting petroleum geologist and engineer at Odessa, Tex.

W. W. Johler, group leader at the Wood River, Ill., refinery of Standard Oil Co. (Ind.), has been named chief chemist in charge of oil inspection and analytical work. Other appointments at the refinery include: **C. R. Ditto,** foreman of the analytical laboratory, named group leader in charge of analytical work and knock testing; **H. L. Hilleary,** group leader, appointed assistant superintendent of the laboratory in charge of general technical service, scheduling, and refinery economics work; and **J. W. Morris,** chemical engineer, appointed group leader in charge of light-oils technical work. The following Standard men have had their titles changed from chief chemists to laboratory superintendents: **A. C. Hershey,** Wood River; **H. M. Steininger,** Sugar Creek, Mo.; **E. K. Brown,** Casper, Wyo.; and **J. C. Bailie,** Neodesha, Kans.

PERSONALS

A.P.I. Mid-Continent Officers

New officers of the Mid-Continent district of the Division of Production, American Petroleum Institute, are shown above following their election in Tulsa recently. Standing, left to right, are: William Pugh, Lane-Wells Co., Great Bend, Kans., area vice chairman for western Kansas; C. A. Husted, contractor, Pampa, Tex., area vice chairman for the Texas Panhandle; K. M. Farnsworth, Atlantic Refining Co., Duncan, Okla., area vice chairman for southwestern Oklahoma; and Glenn Gillespie, Gillespie & Sons Drilling Co., Cushing, Okla., vice chairman for the Drumright area. Seated, left to right, are: G. C. MacDonald, Gulf Oil Corp., Tulsa, retiring district chairman, elected chairman of the District Advisory Committee; Jack Abernathy, Big Chief Drilling Co., Oklahoma City, district chairman; and R. B. McCloy, Stanolind Oil & Gas Co., Oklahoma City, secretary-treasurer. Other officers not in the picture are: H. J. Bourke, Warren Petroleum Corp., Maysville, Okla., vice chairman for the Golden Trend area; R. B. (Cotton) Rundle, Happy Belting Co., Seminole, Okla., vice chairman for the greater Seminole area; and James Puckett, Magnolia Petroleum Co., Wichita, area vice chairman for eastern Kansas.

John W. Cox, driller and petroleum engineer for Phillips Petroleum Co., has been transferred from Fort Stockton, Tex., to Odessa, Tex.

Jimmy Hignight, tool pusher for Delaware Drillers, Inc., has been transferred from San Angelo, Tex., to Sidney, Neb.

E. D. Ruse has resigned, effective April 1, as general production superintendent for National Associated Petroleum Co., Tulsa, to become a bulldozer contractor and consultant in drilling, completing, and producing operations at Sterling, Colo.

W. W. La Mance, formerly a tool pusher for Zephyr Drilling Corp. in West Texas and New Mexico, has become a partner in La Mance Drilling Co. in Midland, Tex.

W. A. Alexander, vice president in charge of the Tulsa area for Shell Oil Co., has been named to head a new exploration and production organization at Denver. The new organization, embracing North Dakota, South Dakota, Montana, eastern Wyoming, and eastern Colorado, is expected to be in full operation by January 1, 1954. At present the over-all responsibility for Shell's exploration and production activities in the Rocky Mountain area is divided between the Los Angeles and Tulsa offices.

Alan T. Knight has been elected to the newly created position of executive vice president of Catalytic Construction Co., Philadelphia.

Frank M. Brewster, Jr., Belmont Quadrangle Drilling Corp., Bradford, Pa., has accepted appointment as a member of the Pennsylvania Grade Crude Oil Association's production research advisory technical committee.

Tyler Brinker has joined Union Oil Co. as an engineering trainee at the company's Whittier, Calif., district headquarters. He recently was released from active duty with the U. S. Army.

Dr. W. J. McGill, general manager of industrial and public relations for Standard Oil Co. (Ind.), will be proposed for election as a new director of the company at the annual meeting of stockholders May 7. The present 14 directors will be renominated. Dr. McGill joined Standard in 1924 as a chemist at its Whiting, Ind., refinery.

O. M. Evans has resigned as vice president in charge of drilling and production for Pacific Western Oil Corp., Los Angeles, to become an independent operator. He has been replaced by **Carl H. Browall,** general superintendent of drilling and production.

Paul Wolff, naval architect and barge design engineer, has been appointed manager of the marine division of the drilling department of Kerr-McGee Oil Industries, Inc. His headquarters will be in Morgan City, La.

S. L. Matheny, Jr., petroleum-engineer trainee for Continental Oil Co., has been transferred from Houston to the company's production offices at Seal Beach, Calif.

Herbert E. Smith, production engineer in training with Sohio Petroleum Co., has been transferred from Russell, Kans., to Pauls Valley, Okla.

Edwin J. Valencia, treasurer of Bishop Oil Co., has been elected to the company's board of directors to fill the vacancy caused by the death of **John M. Jennings,** Houston. Valencia also is a director of Canadian Bishop Oil, Ltd., Bishop's Canadian subsidiary.

Dr. David F. Edwards, assistant head of the petroleum-products division at the Baton Rouge, La., refinery of Esso Standard Oil Co., has been transferred to the East Coast division of Esso's manufacturing department to become assistant general superintendent of the Bayonne, N. J., refinery. He succeeds **W. F. Wadt,** who has been appointed general superintendent of the plant. Dr. Edwards will be succeeded at Baton Rouge by **D. O. Swan,** superintendent of the refining and oil-movement department. Other rotational assignments include: **R. F. Howe,** general foreman, light ends, named to replace Swan as superintendent of refining and oil movement; **R. K. Dix,** head of the process engineering department, named to replace Howe; **D. M. Cox,** assistant head of process engineering, appointed to Dix' post; **N. C. Dunn,** head of the chemical technical service, appointed to replace Cox; **C. C. Garvin,** assistant head of chemical technical service, named to replace Dunn; and **E. T. Craig,** head of the petroleum technical service's cracking group, named to replace Garvin. Technical division changes include: **G. R. Murrell,** group head in the chemical technical service department, moved to group head of

PERSONALS

the petroleum technical service department, replacing Craig; and **W. N. Kestner,** engineer in the chemical technical service department, named to replace Mitchell.

James Helis, assistant regional drilling superintendent for Atlantic Refining Co., in Tulsa, has been assigned temporarily in Dallas to organize and supervise a stratigraphic drilling program.

James W. McDaniel, formerly a geologist for Sunray Oil Corp., at Corpus Christi, has been appointed a geological engineer for E. L. Oliver Co., Oklahoma City.

C. A. Davis, division production engineer for Richfield Oil Corp. at Bakersfield, Calif., has been promoted to district superintendent at Cuyama, Calif.

Wayne C. Moody has returned to Sunray Oil Corp. as staff mechanical engineer at Tulsa following a 9-months leave of absence during which he was chief of the "B" group of the allocation branch of the Division of Production of the Petroleum Administration for Defense in Washington, D. C.

C. Newton Page has resigned as a seismologist for Honolulu Oil Corp. at Midland, Tex., to join Continental Geophysical Co., Fort Worth. He will supervise the company's operations in West Texas and New Mexico and will continue to reside in Midland.

William N. Holt has been named manager of foreign operations in the Eastern Hemisphere for The Texas Co. He formerly was managing director of Caltex (Ireland), Ltd., an affiliate of Regent Oil Co., Ltd., a British company jointly owned by California Texas Oil Co., Ltd., and Trinidad Leaseholds, Ltd.

T. A. Kirk, Dallas independent operator, has been named chairman of the advisory committee of the Kirk Field Operating Committee, which is conducting water flooding operations in the field. Kirk replaces **C. W. Hoffmann,** Eastland, Tex., independent, who has resigned. Hoffmann previously disposed of his large interest in the field. **P. S. Ervin,** consulting petroleum engineer, has been named to the newly created position of general manager. Ervin will continue his independent consulting work.

Earl G. Griffith, formerly district geologist for The Texas Co. at Sterling, Colo., has been appointed a geologist for The Chicago Corp. at Denver.

Charles E. Riddell has been appointed exploration manager for the northwestern division of British-American Oil Producing Co. in Denver. Since September 1952 he has been division geophysicist for Union Oil Co. in the Rocky Mountain area. He also has served as area superintendent for United Geophysical Co. in India, Iraq, Iran, and Turkey and has worked in South America.

William Marlowe has been elected to a 2-year term as president of Mid-Illinois Petroleum Co. Other officers, named also for 2-year terms, include: **Fred Brown, Sr.,** vice president; **Harry Armstrong,** secretary-treasurer, and **Roscoe Bonjean, Glen Durham, Henry R. Alexander, Frank Cremer,** and **Norman Cadigan,** directors.

Stanley B. Radack has resigned as a geologist for Great Lakes Carbon Corp. at Tulsa to become district geologist for Colombian Fuel Corp. there.

A. Hope Dickson has been appointed general manager for pipe-line and terminal operations in Lebanon and Jordan of Iraq Petroleum Co., Ltd. Dickson, who first joined the old Turkish Petroleum Co. in 1926, held the positions of chief accountant and assistant general manager following his return to company service after the war. **J. B. P. Glennie** has been appointed head of I.P.C.'s planning and projects department. He joined the company in 1932 and has been in the London office since the end of the war, first in management (construction) and later in the planning and projects department.

DEATHS

James A. Moffett, 66, former executive of several oil companies and federal housing administrator during the Roosevelt administration, died March 25 in New York. Moffett was the son of an early associate of the late John D. Rockefeller. He joined Vacuum Oil Co. as a clerk in 1906 and subsequently became vice president of Standard Oil Co. (N. J.) and later held a similar position with Standard Oil Co. of California. He also was chairman of the board of California-Texas Oil Co. In 1949 he sued Arabian American Oil Co. for $6,000,000 claiming Great Britain had met urgent financial requirements of Saudi Arabia as a result of his efforts in Washington on behalf of the company. He was awarded $1,500,000 by a jury, but this was later set aside on grounds the alleged contract was against public policy.

Robert D. Bane, 69, retired division superintendent for General Petroleum Corp., died March 13 in his home at Los Angeles.

Sigurd Hallager, 66, Scandinavian manager for California Texas Oil Co., an affiliate of The Texas Co., died in Hartsdale, N. Y., March 22.

Albert R. Kersey, 56, foreman of the pipe-line department of Skelly Oil Co. at Burton, Kans., died March 19 at Halstead, Kans.

James S. Cralle, 50, oil marketer, died in Kansas City, March 17. He had been associated with Kerr-McGee Oil Industries, Inc., for several years.

George Hadley, 75, independent California operator, died March 13 in a car-train accident. He brought in the first oil well in Cuyama field.

Dr. Garrett Kemp, 76, Dallas, former Atlantic Refining Co. geophysicist, died March 23.

Altus Elmo Magness, 40, driller for Shell Oil Co., died March 15 in Fullerton, Calif.

DeWitt Hansen, 73, retired independent oil producer, died March 18 in Tulsa.

Willis Gridley, 55, office manager for A. G. Oliphant, independent oil operator, died March 24 in a Tulsa hospital.

Thurman Clark (Blackie) Pierce, 47, Odessa, Tex., pipe-line contractor, died in Odessa March 22 of a heart attack.

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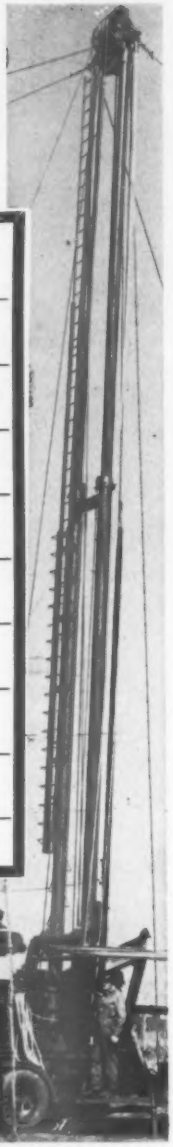

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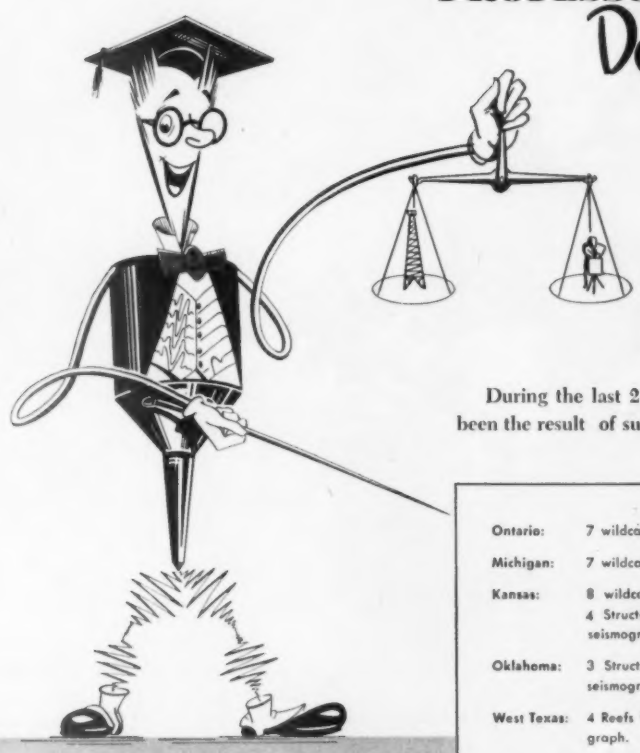

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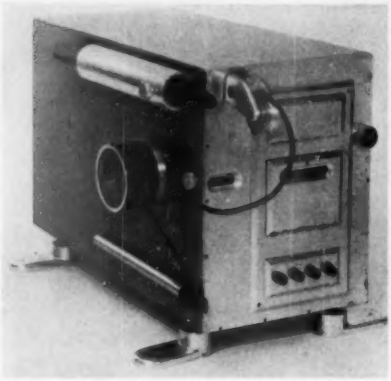

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LOG — A Self Potential and a Resistivity curve are recorded simultaneously on rectilinear paper 3 in. wide. The log is provided with scales of either 50 ft. or 20 ft. to the inch, on opaque or translucent paper or on film. All are suitable for reproduction.

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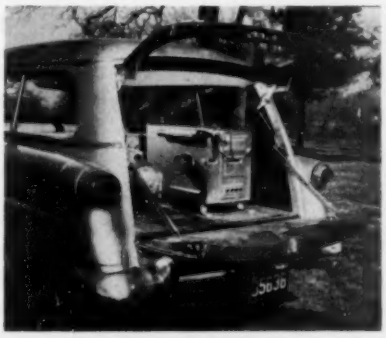

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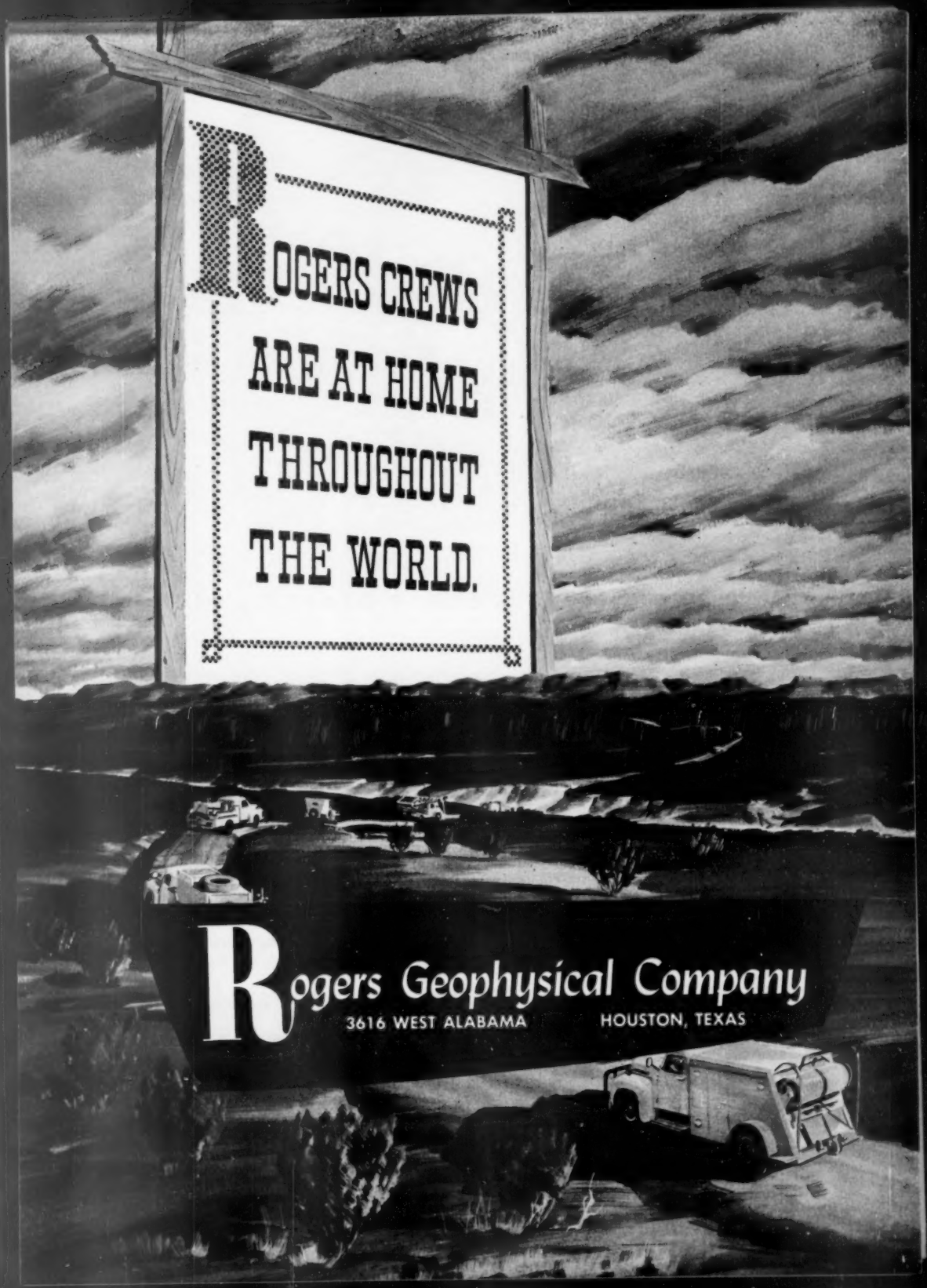
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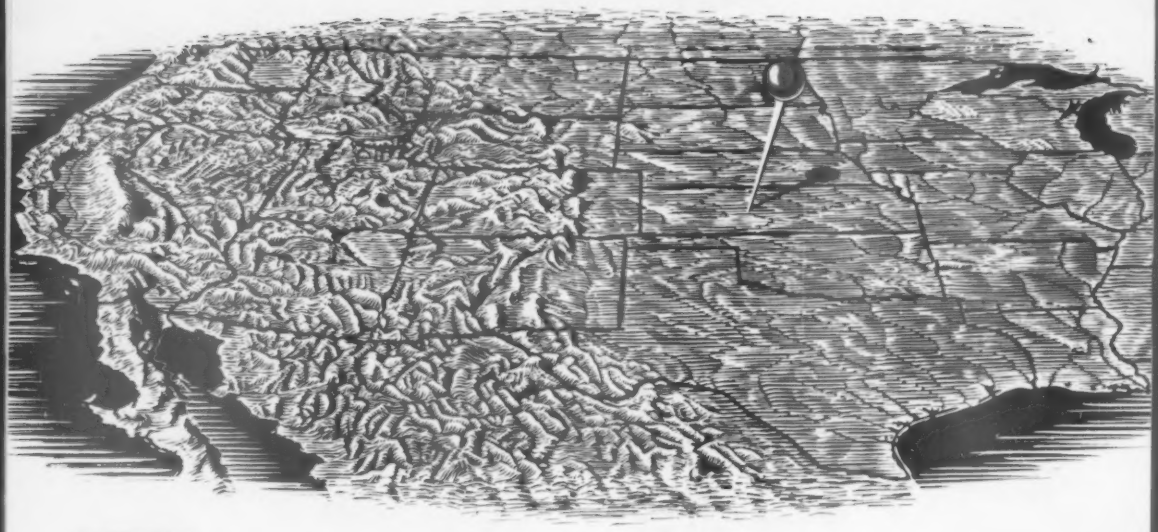

What's so different about Great Bend, Kansas?

That single pin is symbolic of specific problems facing a core analyst in the Great Bend area. Actually the pin could have been spotted at Calgary, or Abilene, or Tyler, or Lafayette — or at any one of Core Lab's twenty-nine field offices. The point is — wherever drilling is in progress the "pay-off" characteristics of oil, gas, and water-bearing formations vary from area to area, basin to basin, county to county, and in large fields, even from well to well.

True, each of our permanent and portable units is equipped with standard core analysis equipment. True, every man who analyzes core for Core Lab follows modern laboratory procedures. Certainly we use Core Lab-developed sets of "average" data for specific areas. So do our contemporaries.

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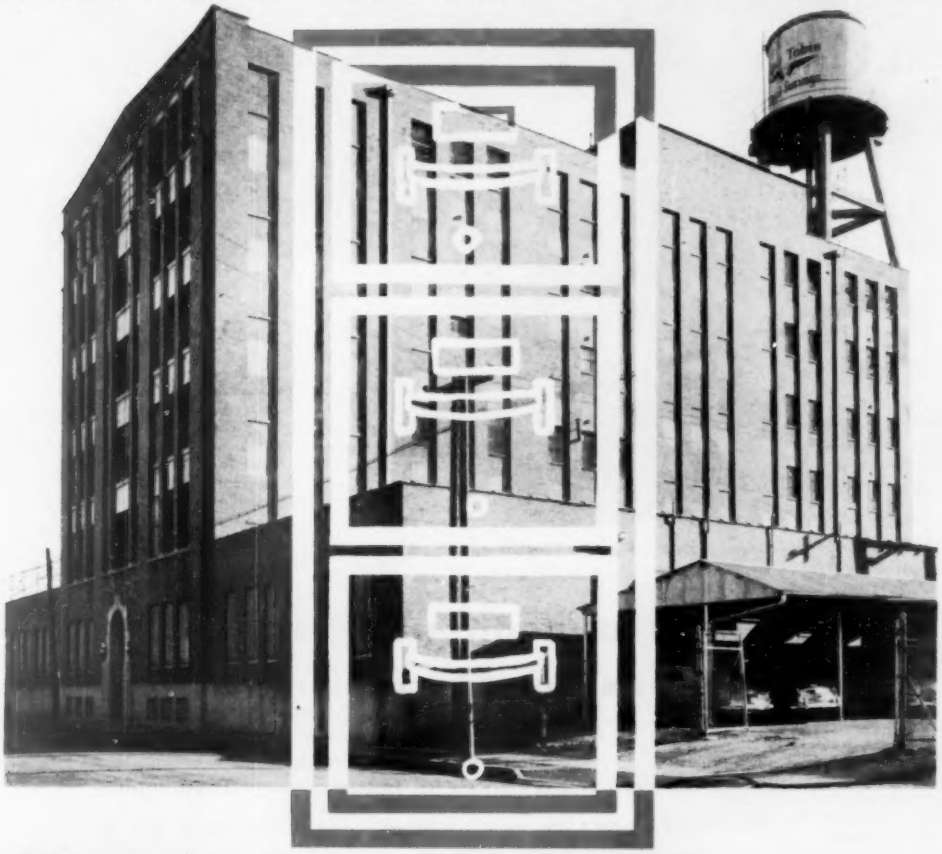

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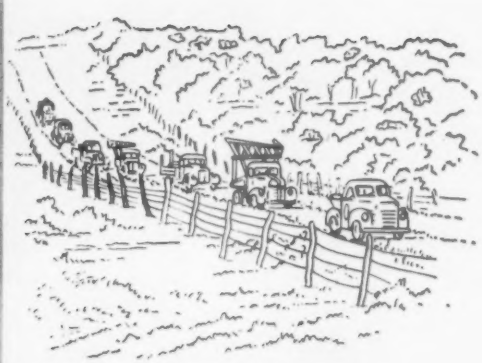

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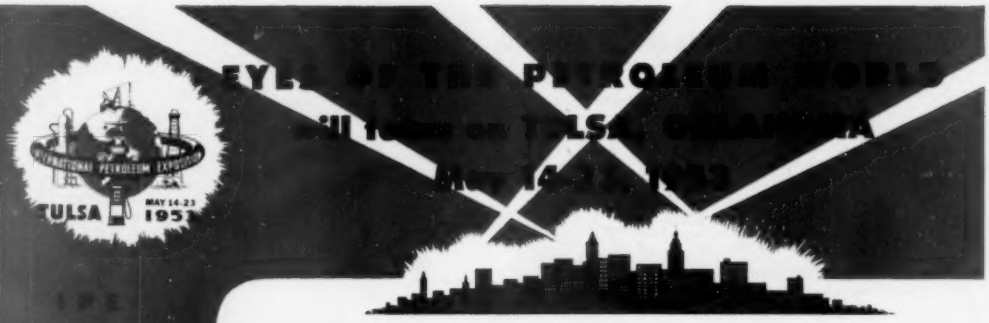

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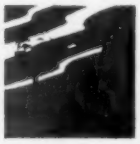

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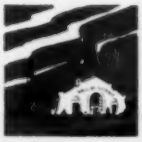

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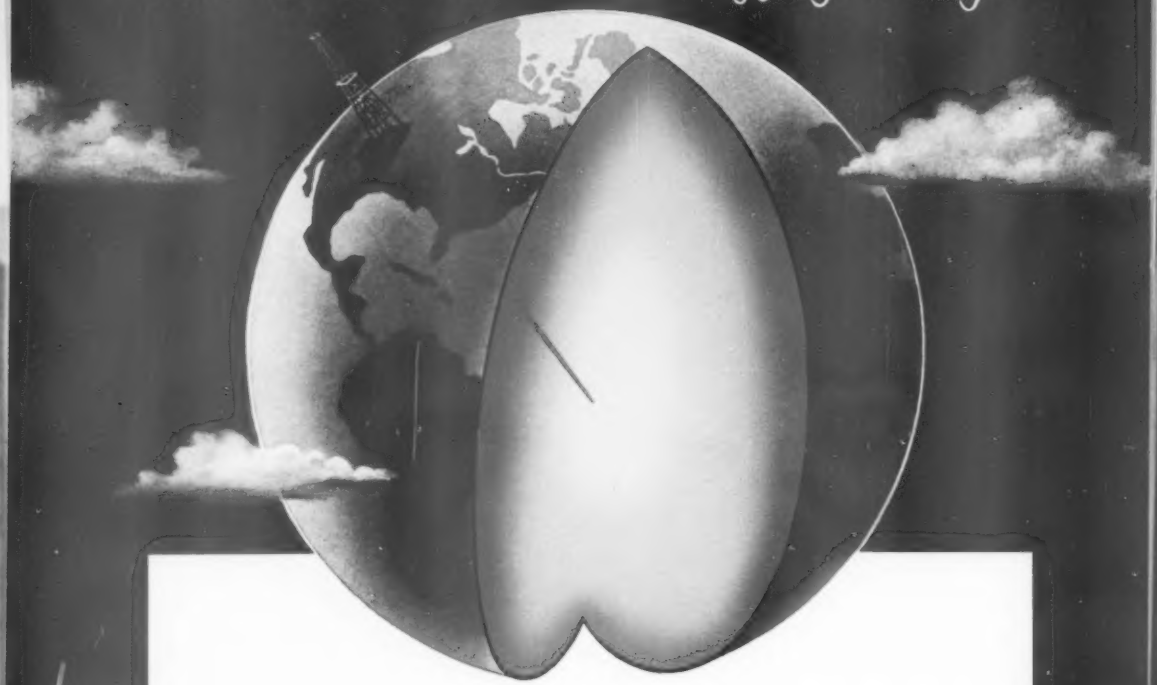

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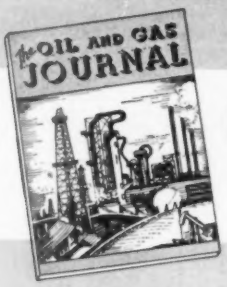

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INDEX

1. California
2. Intermontane Basins
3. Northern Wyoming
4. Williston Basin
5. Kansas
6. Julesburg Basin
7. Hugoton Area
8. Oklahoma
9. North and East Texas
10. Permian Basin
11. West Gulf Coast
12. South Texas
13. East Gulf Coast
14. Miss.-La.-Ark.
15. Tri-state Area
16. Michigan

OIL GAS

PACIFIC OCEAN

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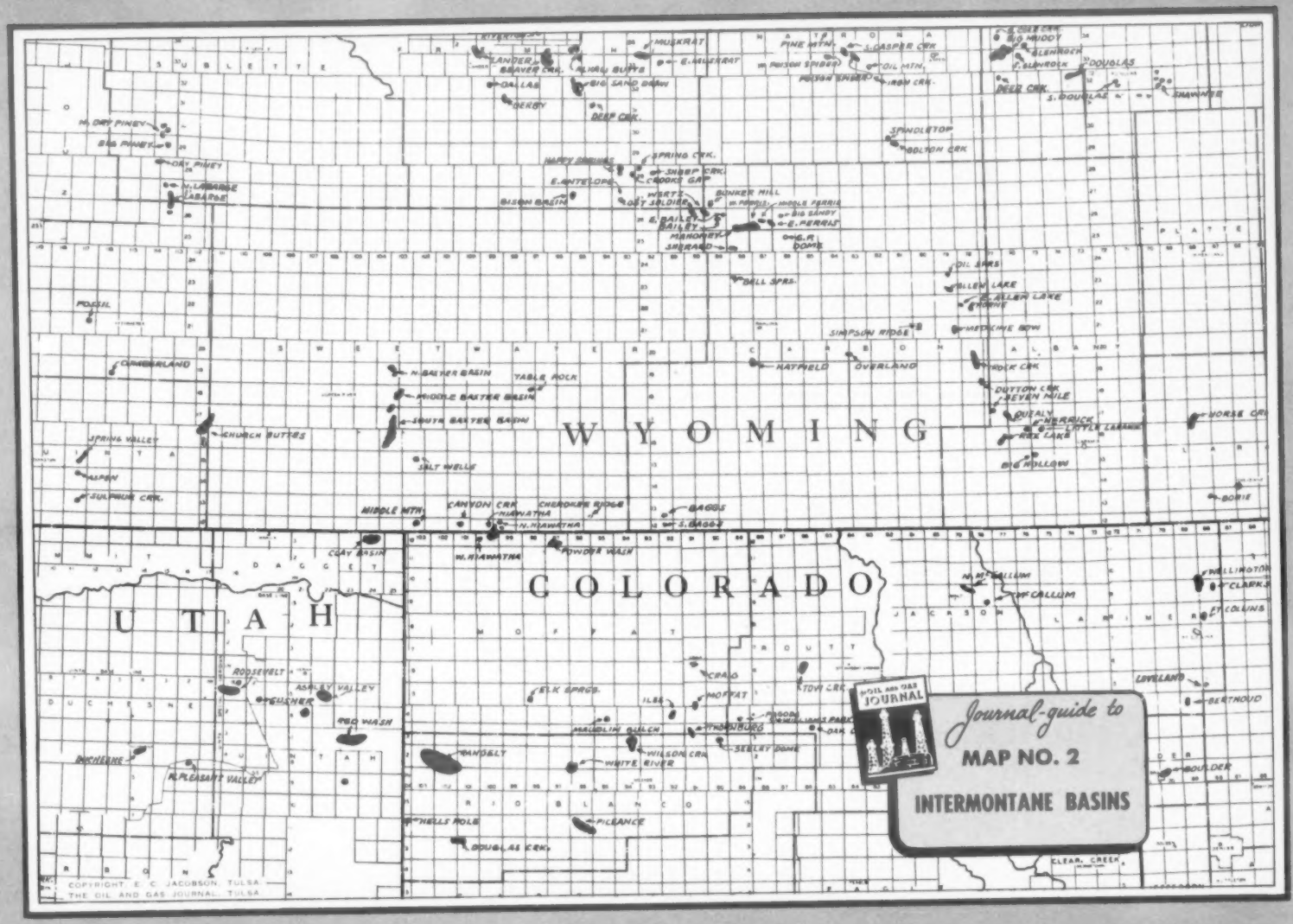
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COLORADO
UTAH
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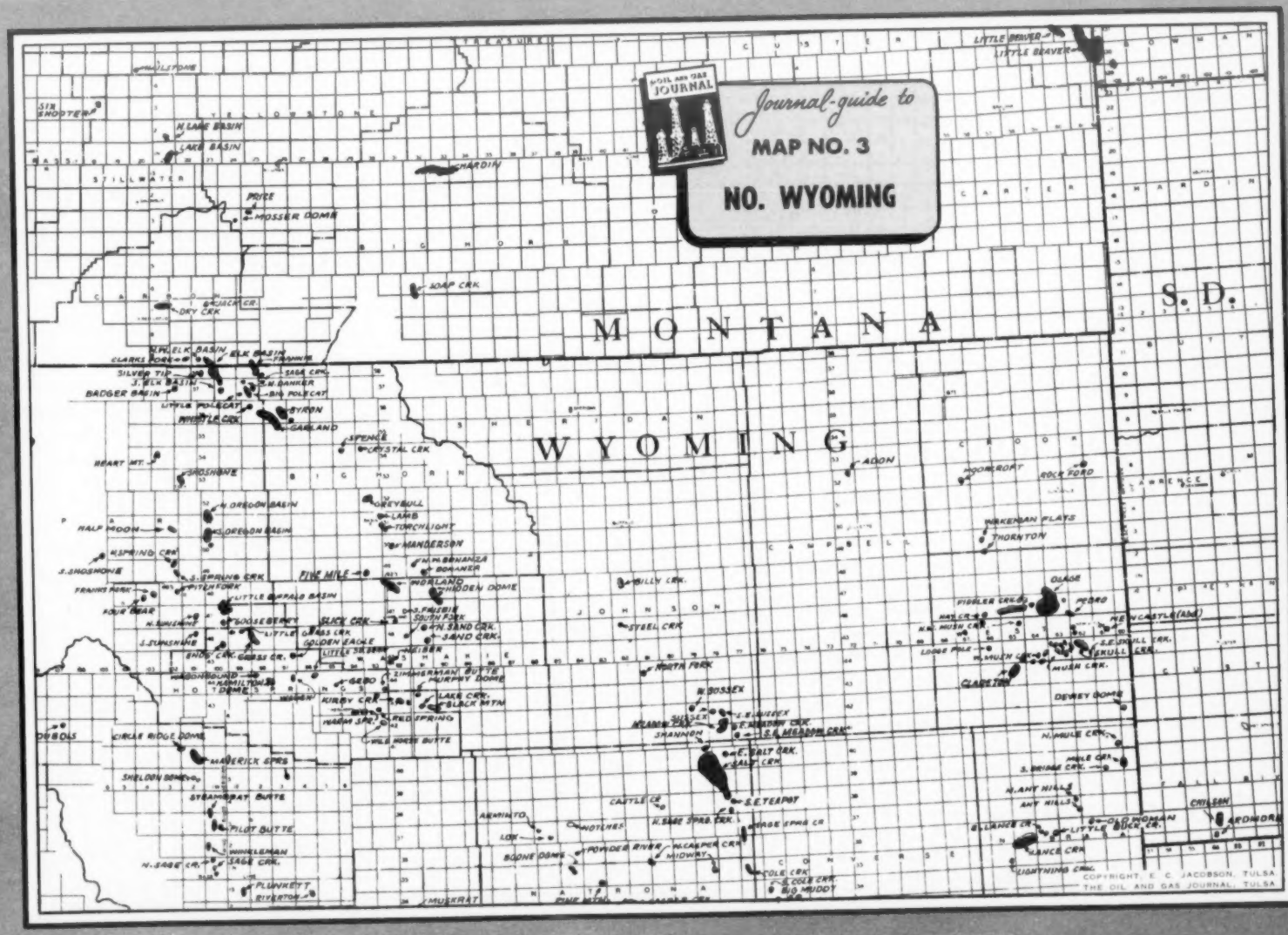
OIL AND GAS JOURNAL
Journal-guide to
MAP NO. 3
NO. WYOMING
MONTANA
S. D.
WYOMING
HARDIN
PRICE
MOSSER DOME
SOAP CRK.
OKY CRK.
ELK BASIN
SILVER TIP
BADGER BASIN
LITTLE POLECAT
BYRON
GARLAND
SPENCE
CRYSTAL CRK.
BEART MT.
SHOSHONE
N. OREGON BASIN
OREGON BASIN
HALF MOON
GREYBULL
LAMB
TORCHLIGHT
MANDERSON
N. SPRING CRK.
S. SPRING CRK.
PITCHFORK
FINE MILE
MORLAND
HIDDEN DOME
FRANNY RUSC
LITTLE BUFFALO BASIN
FOUR BEAR
GOOSEBERRY
SLICK CRK.
GRASS CRK.
GOLDEN EAGLE
SAND CRK.
GIBBS CR.
HAMILTON DOME
GEBO
AURORA SPR.
RED SPRING
WILD HORSE BUTTE
DEBOLS
CIRCLE RIDGE DOME
MAVERICK SPRS.
SHELDON DOME
SYBANDY BUTTE
PILOT BUTTE
WHEELEMAN
SAGE CR.
N. SAGE CR.
PLUNKETT
RIVERTON
MUSKRAT
ADON
ROCK FORD
BAKERMAN FLATS
THORNTON
BILLY CRK.
STEELL CRK.
NORTH FORK
SUSSEX
E. SUSSEX
E. SALT CRK.
SALT CRK.
S.E. TEAPOT
CASTLE CR.
NOTLINES
N. SAGE SPRS. CRK.
SAGE SPRS. CR.
BOONE DOME
POWDER RIVER
MIDWAY
COLE CRK.
BIG MUDDY
GLADE
PEORD
CASTLE(TANK)
MUSH CR.
LODGE POLE
GLADSTEN
DEWEY DOME
N. MULE CR.
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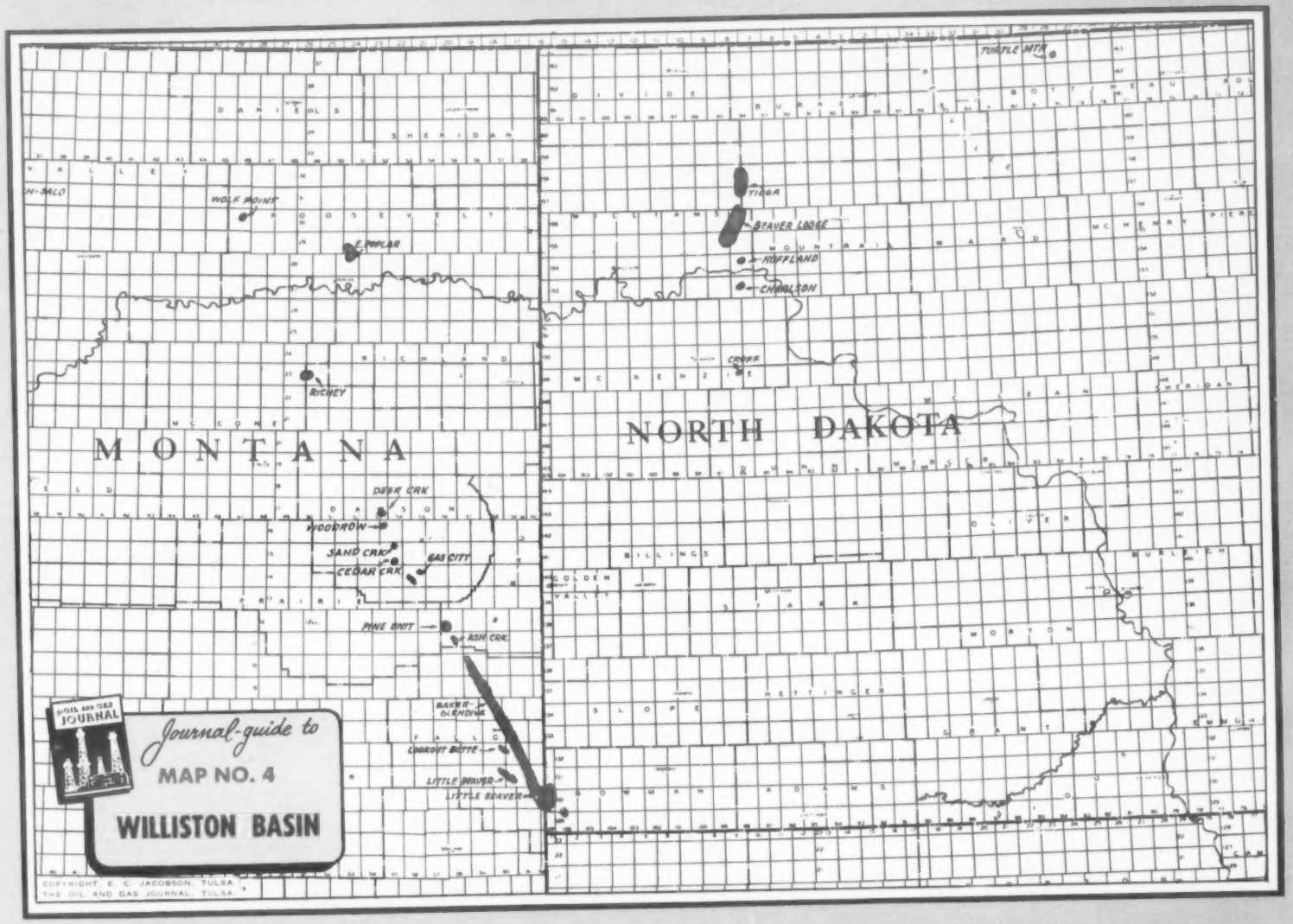
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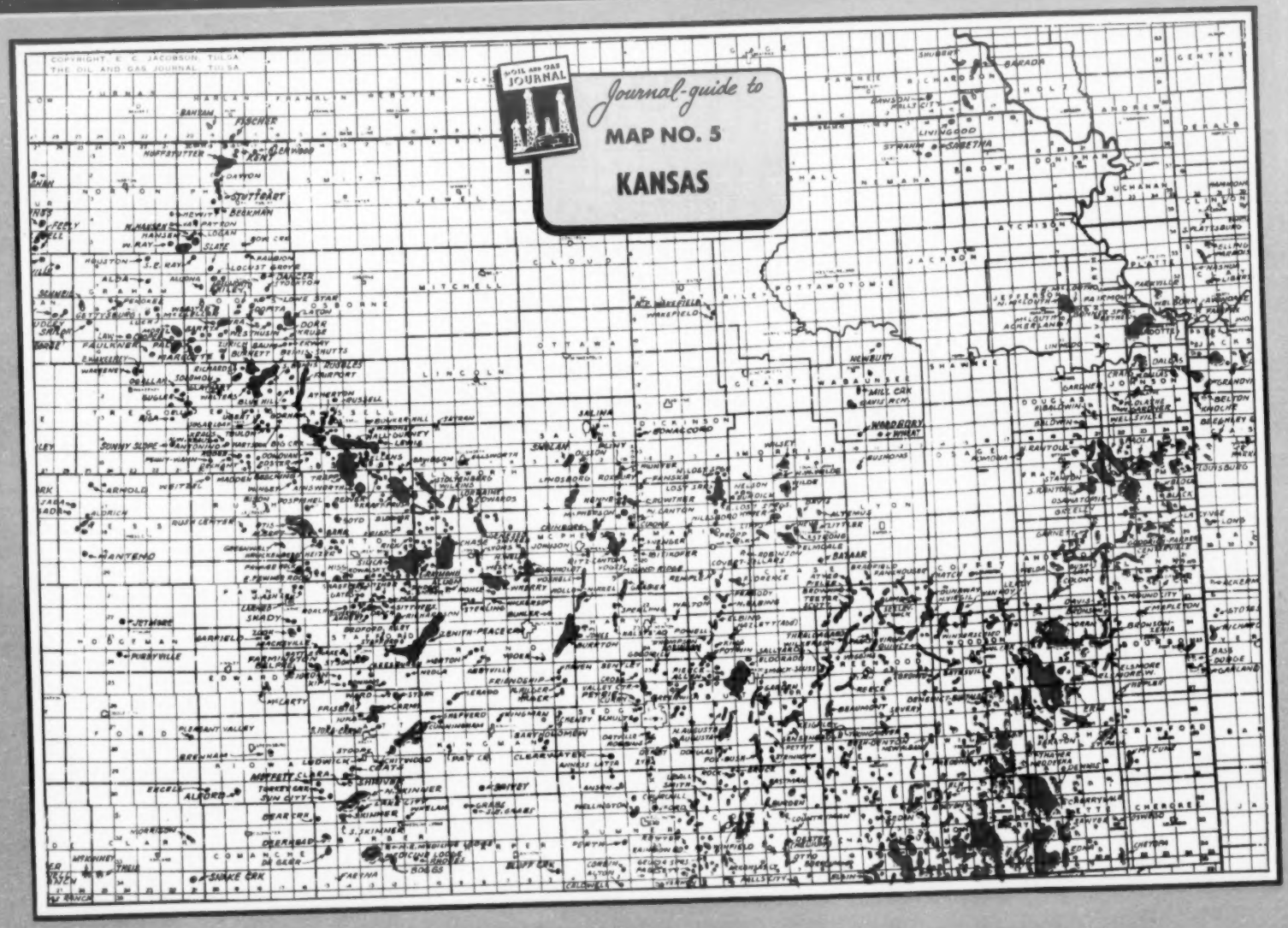
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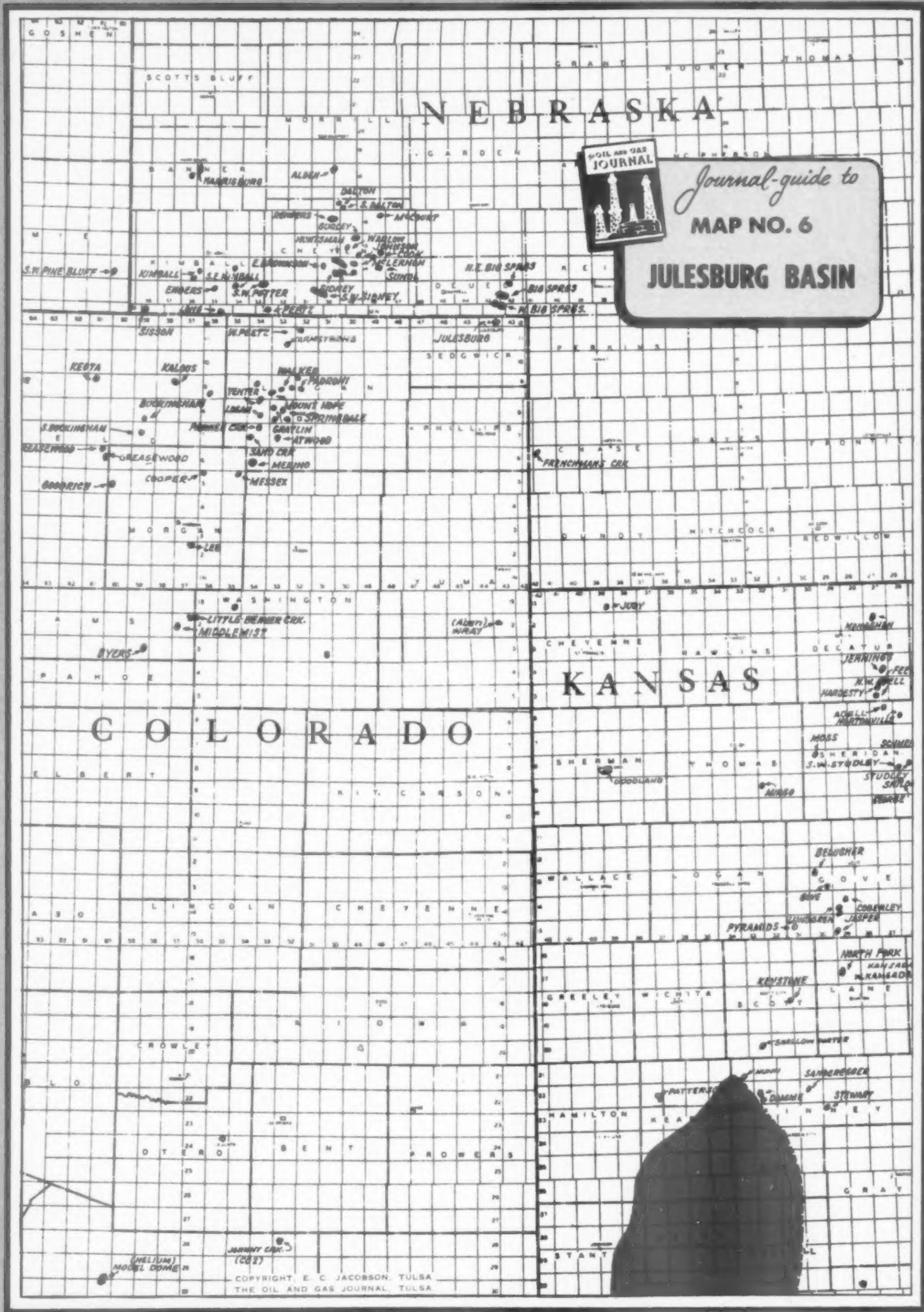

NEBRASKA
OIL AND GAS JOURNAL
Journal-guide to
MAP NO. 6
JULESBURG BASIN
COLORADO
KANSAS
GOSHEN
SCOTTS BLUFF
MORRILL
GARDEN
GRANT
HOOKER
THOMAS
BANNER
HARRISBURG
ALDEN
DALTON
S. DALTON
McCOURT
BURGEY
HUNTSMAN
KIMBALL
S.W. PINE BLUFF
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S.W. POTTER
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S.W. SIDNEY
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BIG SPRGS
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DUNDY
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REDWILLOW
SISSON
W. PEETZ
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KESTA
KALOUS
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MOUNT HOPE
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S. BUCKINGHAM
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SHERMAN
GOODLAND
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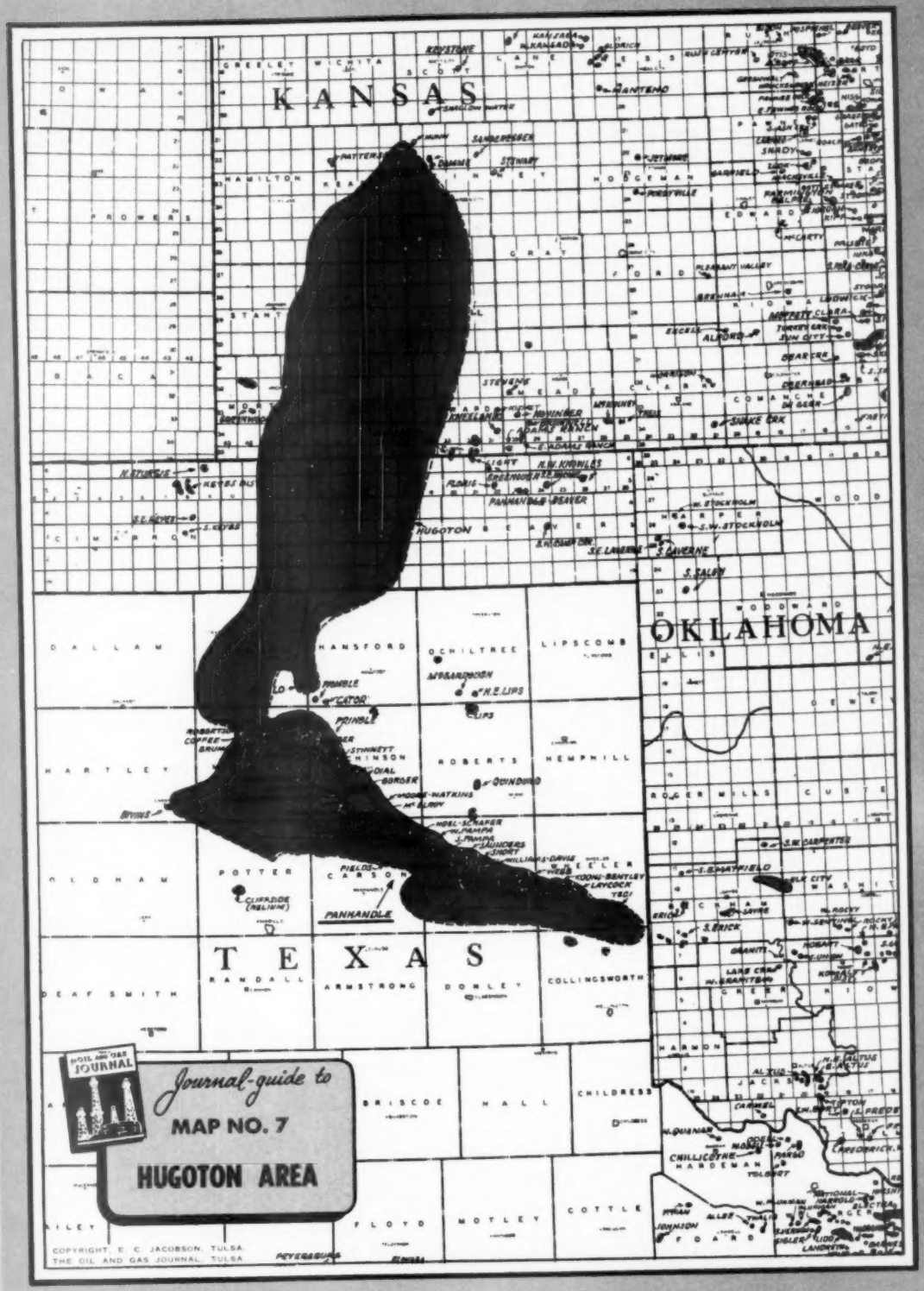
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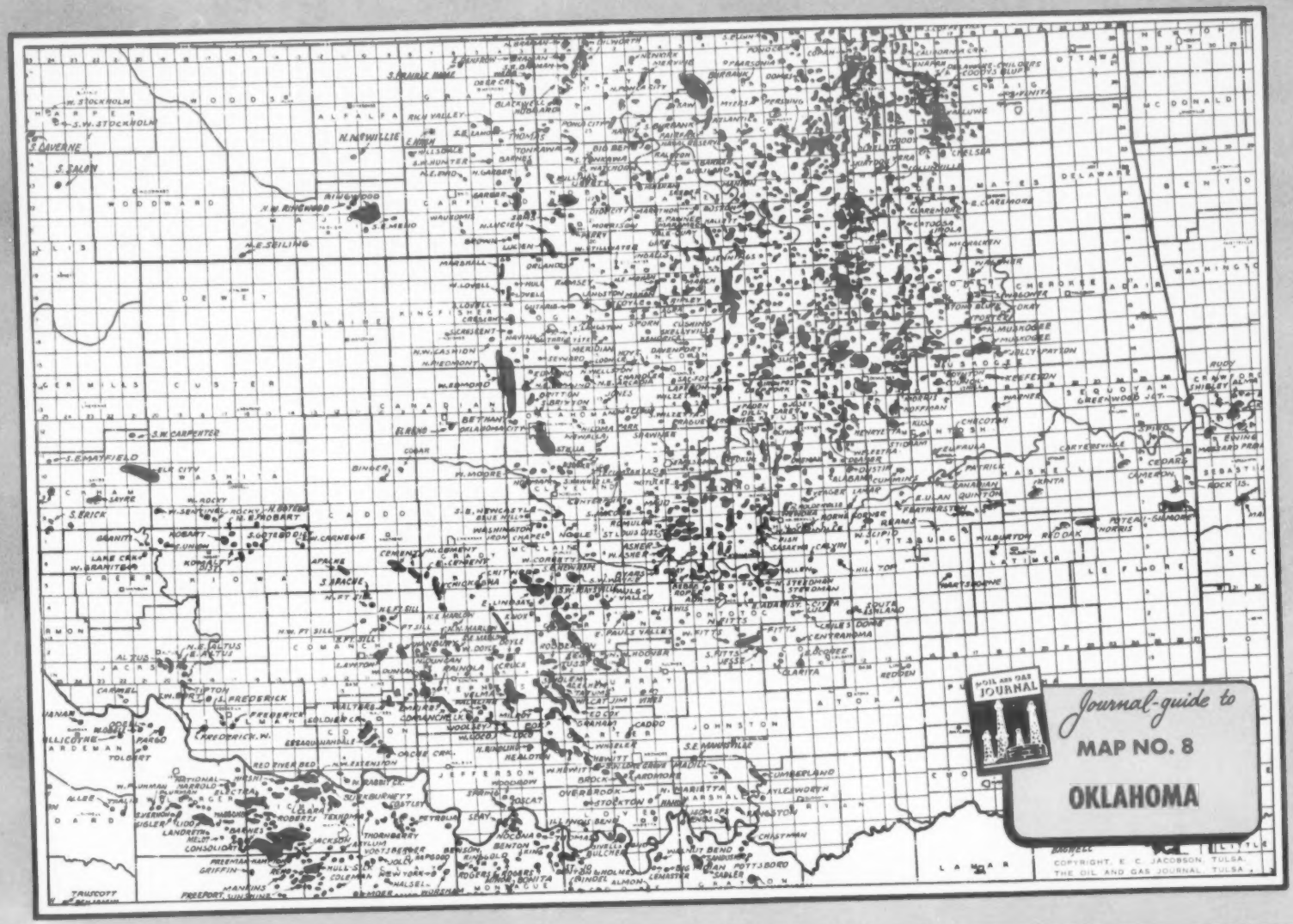
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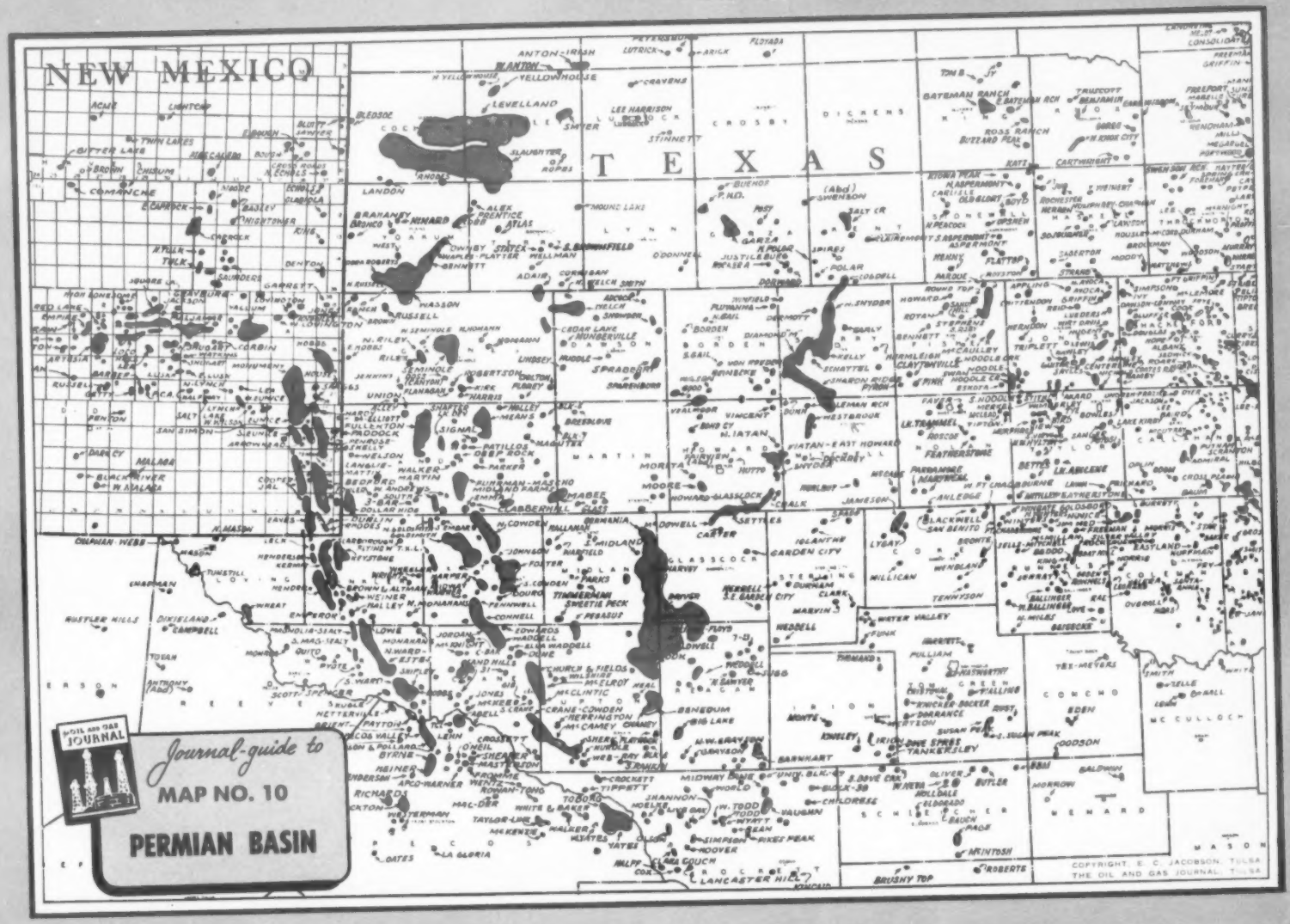
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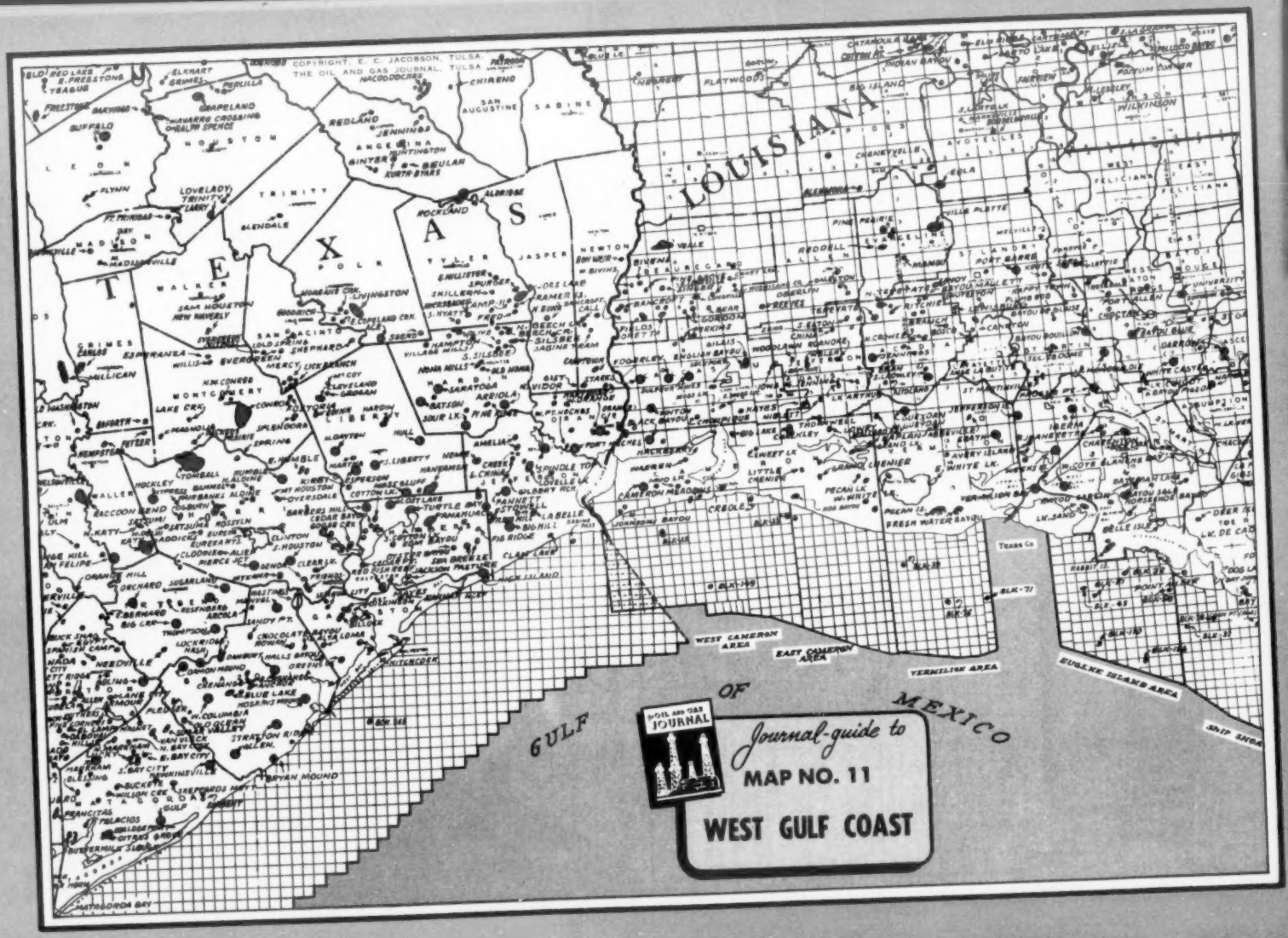
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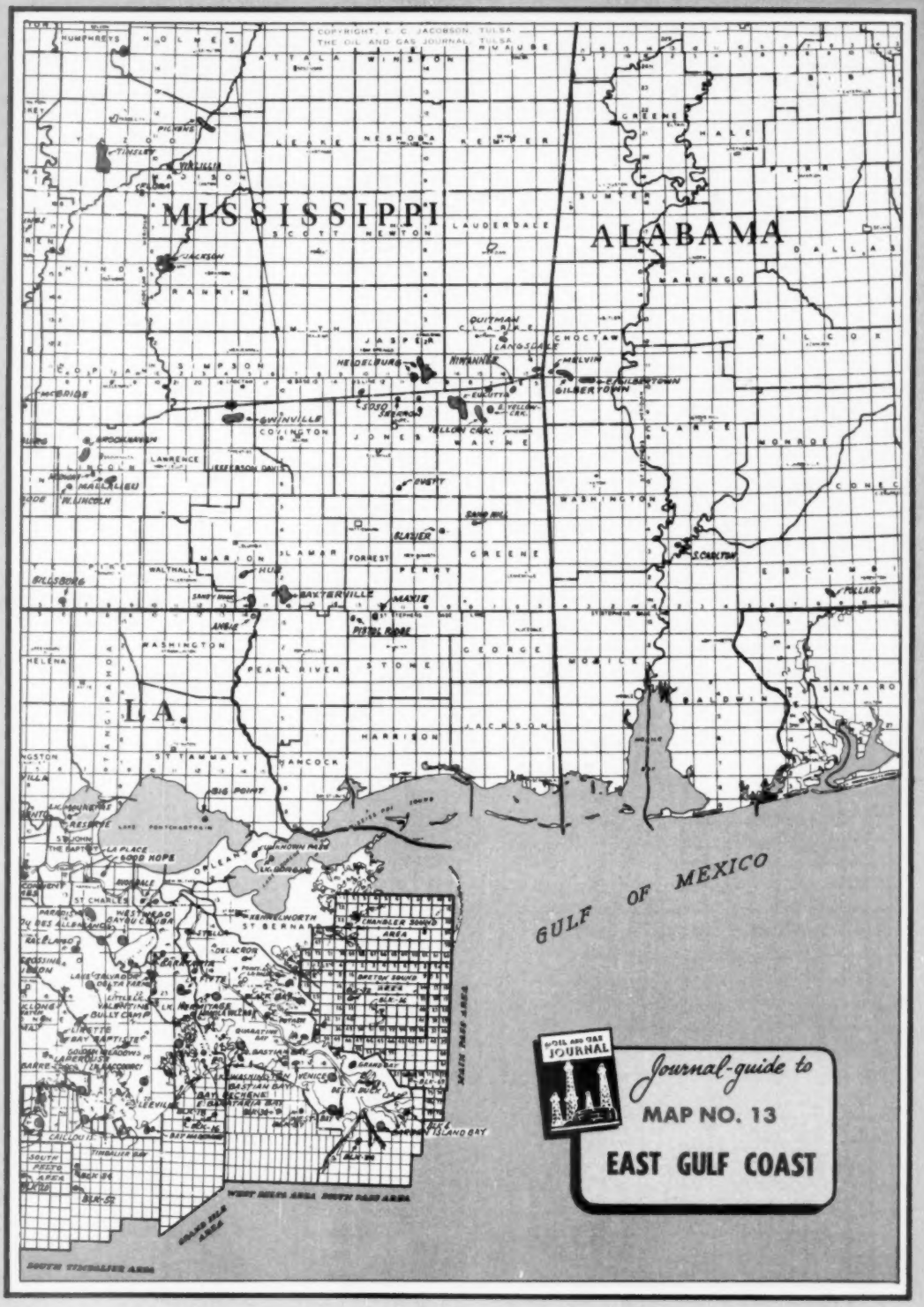
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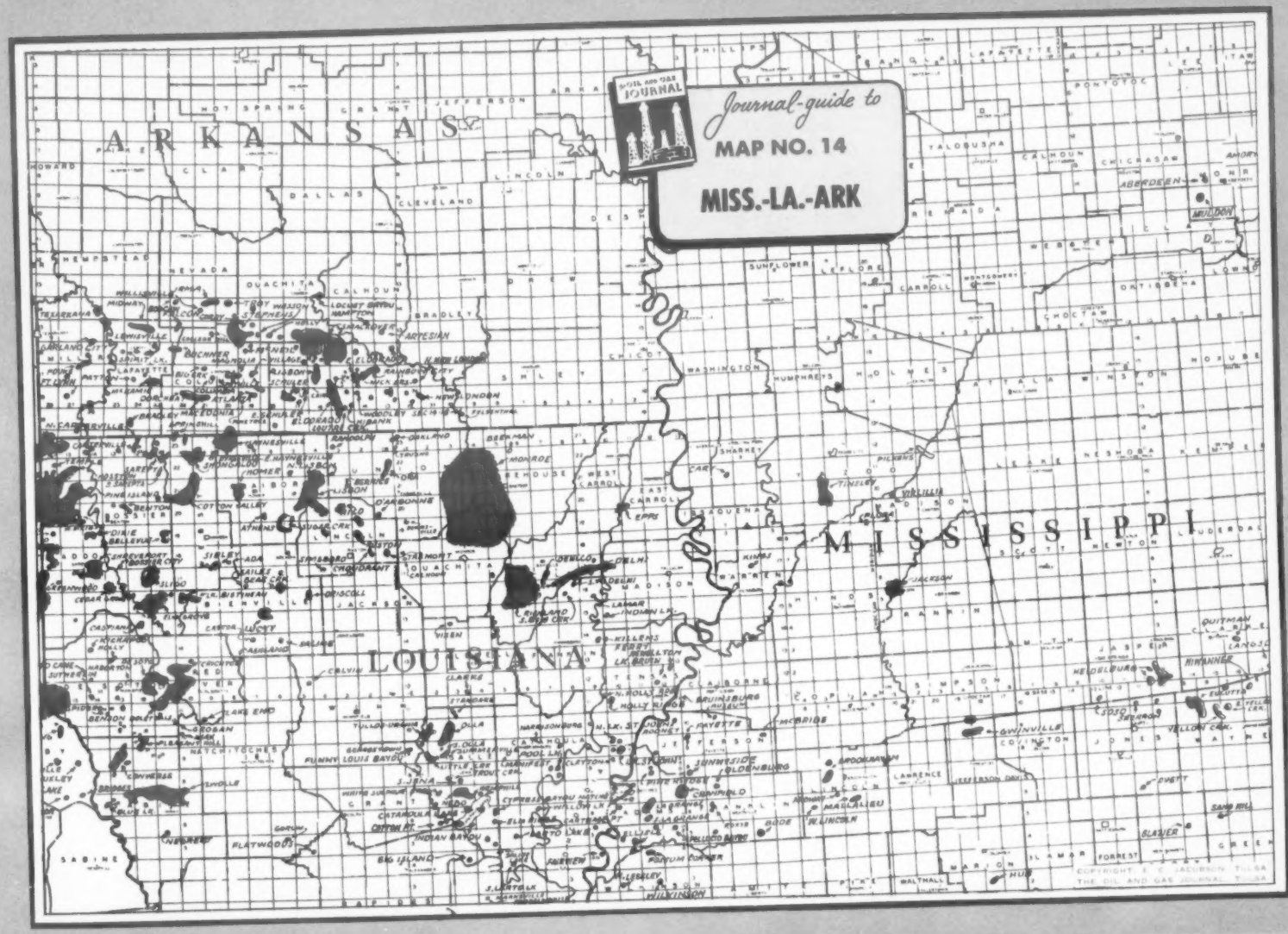
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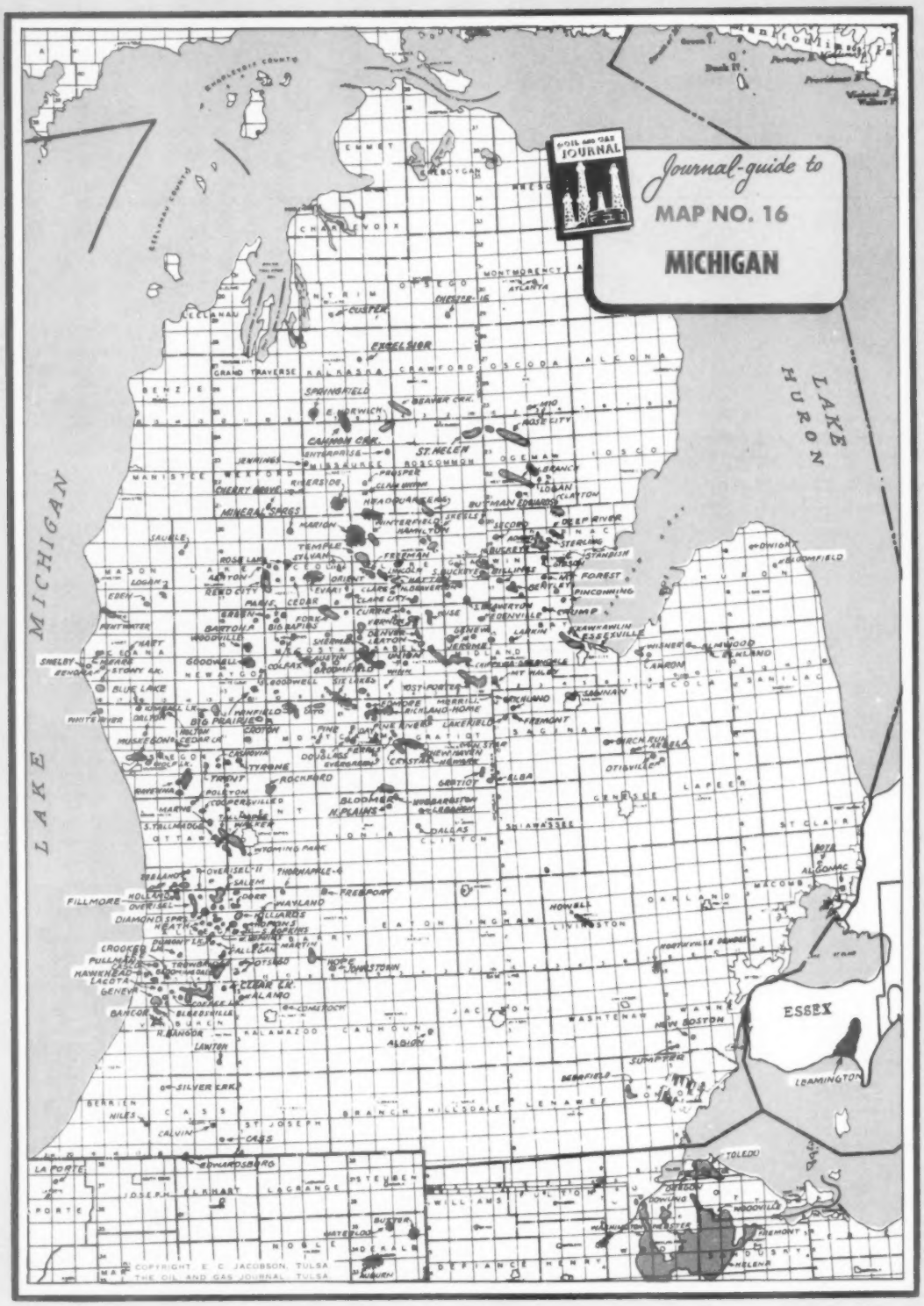
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The Need for Quantity and Quality in

VELOCITY SURVEYS

A Symposium . . .

Conducted under the auspices of the Geophysical Society of Tulsa

THE PARTICIPANTS . . .

Francis Cady, geophysical computer, Carter Oil Co.; Neil Sparks, seismologist, Stanolind Oil & Gas Co.; Paul L. Lyons, exploration manager, Anchor Petroleum Co.; John E. Owen, physicist, Geophysical Research Corp.; R. C. Kendall, area geophysicist, Shell Oil Co.; B. G. Swan, chief geophysicist, Continental Oil Co.; and L. Y. Faust, geophysicist, Amerada Petroleum Corp., moderator.

Why the Symposium Was Held

by L. Y. Faust, Moderator

ONE of the outstanding developments in seismic prospecting during the past 2 years is the tremendous increase in the number of velocity surveys that are being made available to the industry. No small portion of the credit for the interest shown in this subject is due to John Daly for his excellent work in disclosing the large velocity variations in West Texas.

The purpose of this symposium was to raise questions concerning the optimum density of velocity surveys and the optimum precision of these surveys.

Assuming that one goal of seismic exploration is the accurate mapping of the attitude of geologic horizons, attention should be called to the fundamental equation of the reflection method:

$$Z = Vt/2$$

where Z is the depth, t the vertical reflection time, and V the corresponding average velocity. This formula shows that an error of 0.01 second either in the measurement of or the assumption concerning the velocity to depth Z is equivalent to an error of 0.02 second in the measurement of reflection time.

Figs. 1 and 2 illustrate certain consequences of this relationship. These figures show a portion of a reliable survey. Fig. 1 shows the discrepancy in feet between the seismic data and the corresponding geologic marker when the velocity is assumed constant. The distance between the well showing an error of +800 ft. (that is the seis-

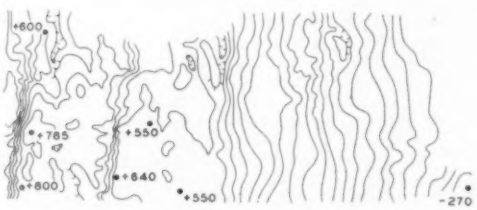


Fig. 1—Well-miss using constant velocity.

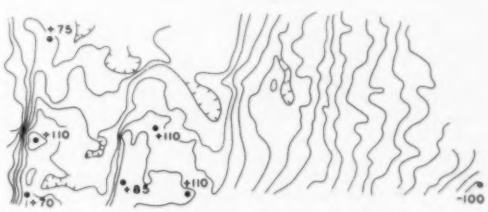


Fig. 2—Well-miss using controlled velocity function.

mic datum 800 ft. deeper than the geologic marker) and the well showing an error of —270 ft. is approximately 25 miles.

In Fig. 2 the same data have been recomputed on the basis of a velocity function related to depth and geologic time. This function is corrected laterally by two velocity surveys within the area as well as by other surveys adjacent to but beyond the limits of the area. The errors are much smaller in Fig. 2, being generally about 100 ft. deeper than the geologic tops. However, one well is 100 ft. shallower than the geologic horizon. A good velocity survey was available in this well and discloses the strong probability of a correlation error of one cycle. A subsequent well drilled a few miles beyond the limits of Figs. 1 and 2 failed to check by 200 ft. and a velocity survey run in this well showed that the error was due to velocity.

This introduction illustrates four points to be discussed by this panel, namely:

1. The assumption of a constant velocity is erroneous.

2. A reasonably accurate representation is possible with a small amount of velocity control.

3. Large errors of prediction may eventually occur due either to miscorrelations or to lack of adequate velocity control.

4. High precision surveys in sufficient quantity are necessary to resolve the cause of error.

How to Make Effective Use Of Velocity-Survey Data

by B. G. Swan

AS my contribution to this symposium I should like to elaborate somewhat on the question of the practical limits to the density—or quantity—of well velocity surveys.

When we use the word "practical" we immediately think of costs.

Purely in dollars and cents costs, my own company last year spent less than 1 per cent of its total geophysical operating expense on well velocity surveys. While it can be argued with considerable authority that the dollars and cents "book" cost of a survey is not a proper measure of its true cost—because the intangible expense of high-level supervision, interruption of exploratory programs, and such are not truly represented—I doubt very much that costs are a factor of importance as yet.

If we thus rule out the cost factor in a consideration of the practical limits to the number of well surveys which any company should obtain, then it seems necessary to go into the ultimate use of the velocity data. The root of the problem, and the one most difficult of being resolved to everyone's satisfaction, is the effective utilization of the velocity data we do obtain in increasing our oil-finding ability. While I doubt the necessity of arguing the point with practicing geophysicists, most of my remaining remarks are related to this aspect of the problem.

Lateral Velocity Gradients

I do think there are good possibilities of increasing the effectiveness of our oil-finding technique. Also, that we need to obtain a high density of well velocity data as insurance against going astray because of an unawareness of the problem.

That lateral velocity gradients of 100 to 200 ft. per second per mile are not at all uncommon in some areas is amply illustrated in two published papers with which I am familiar. The first of these is by E. J. Stulken, published in the October 1941 issue of Geophysics. The other is by John Daly and C. N. Page in the April 1952 Bulletin of the A.A.P.G. Accompanying illustrations also show gradients of that order of magnitude.

The magnitude of the effect of velocity variations on observed seismic reflection times has been demonstrated in a number of illustrations in the two papers just referred to. The paper by Daly and Page perhaps presents the extremes in that it deals with reef areas in West Texas, but this area differs only in degree from almost any

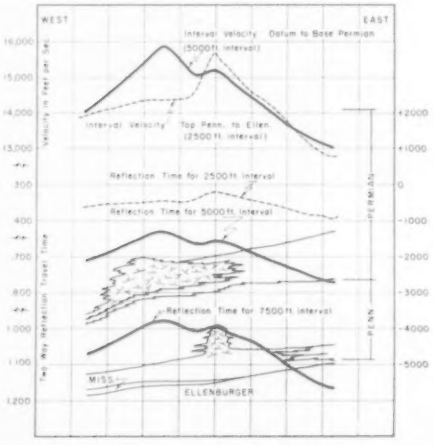


Fig. 1—Illustration of lateral velocity gradients of 100 to 200 ft. per second per mile.

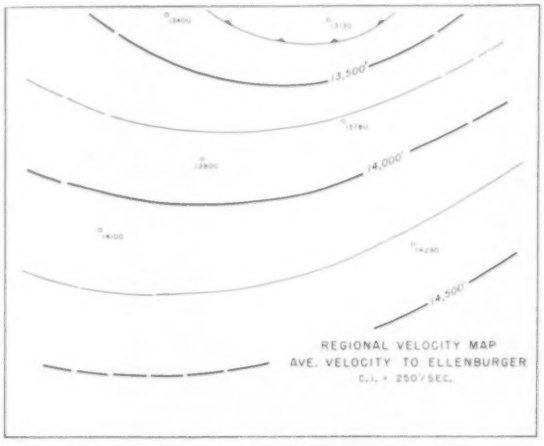


Fig. 2—Regional velocity map to top of Ellenburger based on six well surveys.

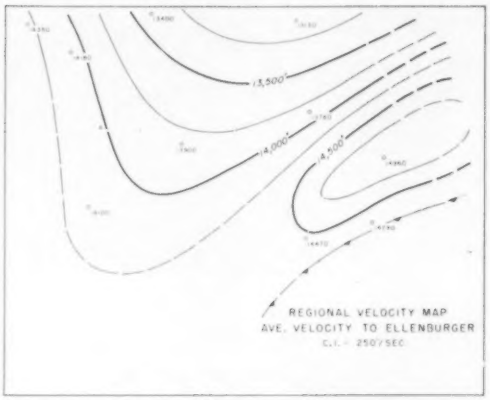


Fig. 3—Same area as in Fig. 2 after four additional surveys had been made.

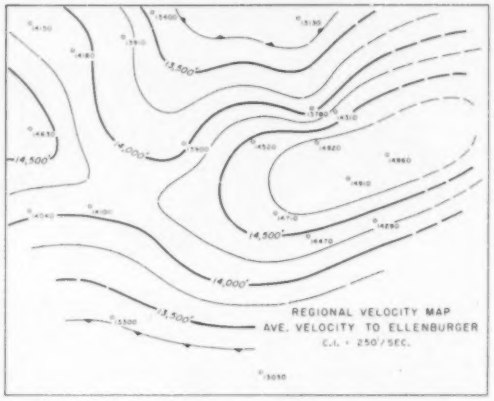


Fig. 4—Same area as in Figs. 2 and 3 after 10 more surveys were available.

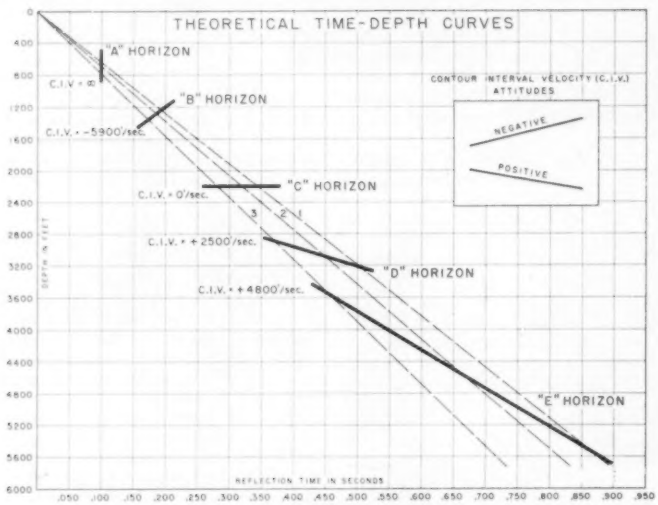


Fig. 5—Three theoretical time-depth curves similar to well-velocity curves.

area one may select. In Fig. 1 have been combined many of the data from Figs. 15 and 16 of that paper. Note that, although the Ellenburger is prescribed as being flat, in computing the reflection time to that horizon 94 milliseconds of east time dip is introduced by the viscosity gradient—over the full length of the line. Still more striking is the distortion created by the two reefs. From the easternmost of the two time highs, 189 milliseconds of east time dip is introduced.

In the matter of optimum density of well velocity survey control, three figures are of interest. These figures were prepared to show three stages in the development of a regional velocity map. The data are from our files, though an attempt has been made to camouflage the actual locations. The area covered is something more than a county in size.

In Fig. 2 the contours are based on six well surveys and show the velocity from the base of the weathering, approximately, to the top of the Ellenburger. Note the uniform gradient. Fig. 3 shows the map after 4 more surveys were added, and Fig. 4, after the full 20 surveys were available. I think it is safe to say that 20 surveys are not too many in this particular area.

Time-Depth Curves

Since this discussion is concerned with a more effective utilization of velocity data, I should like to mention some personnel thoughts on the use of time-depth curves. I have a feeling that use of such curves in the routine computation of seismic data may have led to a slower recognition of the importance of ample areal velocity control. They are necessary, in some form, of course, in the plotting of depth cross-sections and in dip displacement work.

However, fundamentally the use of such a curve over an extended area implies the assumption that any lateral velocity gradients—due to change in structural position or any other reason—are identical to the vertical gradients on the curve used. The curve is usually based on well-survey data, but it actually applies only at the one specific point or geographic location where the survey was made. In practice, of course, various schemes have been devised to correct for lateral gradients, but in my opinion there is danger in such corrective methods that do not present a clear areal picture of the velocity distribution.

In Fig. 5 are shown three theoretical time-depth curves similar to well velocity curves. The heavy lines connect points on the curves at five correlated geologic horizons. These lines may be considered as computing curves for reflections from their respective horizons. If one is computing depth differences from differences in vertical reflection times, the slope of these lines defines the proper velocity to use. It might be called "contour interval" velocity for use in inspection of maps contoured in time. Only straight lines are shown, although actually they might be curves. Note that the values of these velocities range from infinity at "A" through minus 5,900 ft. per second at "B" and zero at "C" to plus 4,800 ft. per second at "E."

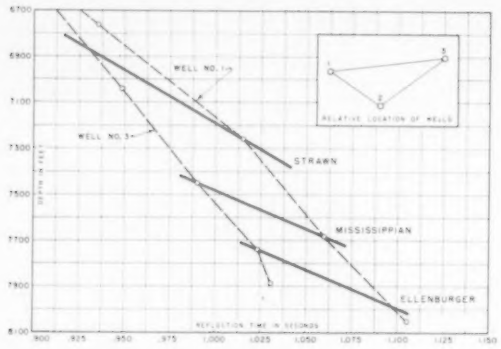


Fig. 6—Portions of time-depth curves (two wells).

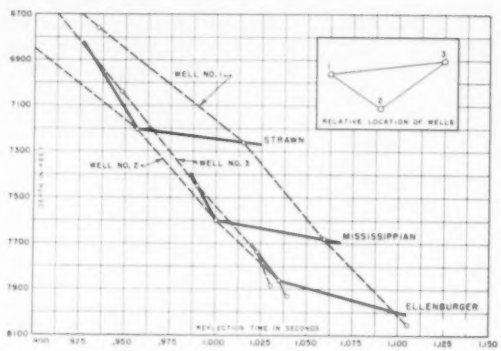


Fig. 7—Portions of time-depth curves (three wells).

Of course, this represents only hypothetical data, but it does illustrate, to my mind at least, the effects non-uniform areal velocity distribution may take when presented on a common graph sheet in the form of time-depth curves.

Fig. 6 shows portions of two well-survey curves in West Texas. The time-depth relations between Wells 1 and 3 appear quite simple. However, when Well 2 is added, as in Fig. 7, it is evident that we would have gone considerably astray in any depth computations based on the simple relations of the preceding slide.

If the routine use of time-depth computing curves does have the effect of obscuring the need for wider and more detailed well velocity-survey data, as previously stated, I think the opposite is true of the use and study of contoured velocity maps.

Regional Velocity Maps

I should also like to offer the observation that the correlation and study of subsurface and well velocity-survey data in the early stages of exploratory development of a geologic basin, or province, is worthy of increased attention by geologists and geophysicists. This was touched on in the paper by Daly and Page. One of the best ways to initiate such a study is through regional velocity maps.

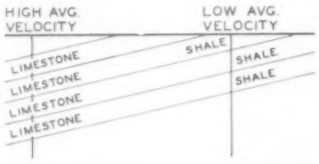
As an example, I was at one time intrigued by the appearance on one of our maps of a high-velocity trend which seemed to be developing across the center of a basin. Investigation showed that there was indeed an old positive area at that location which possibly may have had a significant influence on the depositional history of the adjoining portion of the basin. The full significance of this had not previously been recognized by our geologists and geophysicists.

Likewise, facies changes may be detected through velocity maps and valuable deductions made concerning the basin's geologic history which can possibly be used in a more effective exploratory program.

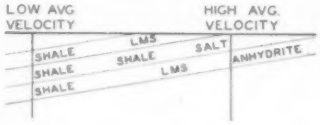
Some general observations of interest which are apparent through examination of regional velocity maps in our files are:

1. Average velocity to a constant depth or time decreases basinward in the Gulf Coast, Anadarko basin, and the Midland basin. (This should be the normal situation where younger sediments of lower velocity are added basinward).

2. Average velocity to a geologic horizon increases basinward in the Gulf Coast, Anadarko basin, and on the Dakota horizon in the Powder River basin. (Contributors to this are changes in lithology and compaction.)



3. Average velocity to a geologic horizon decreases basinward on the east side of the Midland basin. (This is the opposite of the preceding example and may be explained by the development of high-velocity reef material in the shallower near-shore portions of the basin.)



You no doubt get the general idea that I am pretty well sold on the need for plenty of velocity control. I am. I do not think we have yet reached the point where we need seriously worry about getting too much.

Cooperative well-shooting associations were one of the measures sponsored early in development of the seismic method by far-thinking exploration geophysicists to encourage the accumulation of authentic velocity data. There is no doubt but that this effort has been successful. However, I should like to put in a word for less formal and rigid bylaws for the conduct of surveys by these cooperative associations. It is just my opinion, of course, but I feel quite strongly that the modern trend in these associations toward more and more "regulations" and requirements is scaring away prospective nominators, and is resulting in lesser participation by many companies who might otherwise be interested. I don't know the answer, but perhaps one solution is indicated in the increased number of surveys made by individual companies and which are then sold or traded to others in the industry to reduce unit cost. In my own company, of the 34 surveys we have made in a period of almost 2 years, only 4 were association-sponsored surveys.

"... facies changes may be detected through velocity maps and valuable deductions made concerning the basin's geologic history which can possibly be used in a more effective exploratory program."

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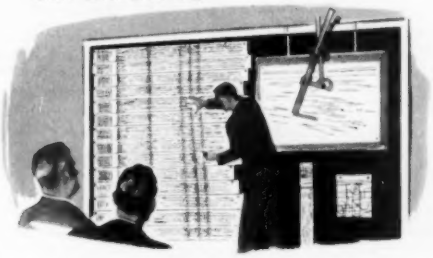

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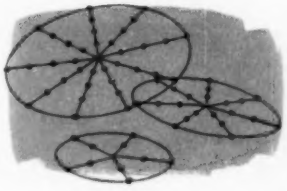

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How to Improve Survey Accuracy

by Robert C. Kendall

HERE'S how to improve the accuracy of velocity surveys. It is assumed that velocity surveys are of value and no attempt will be made to defend the collection of velocity data, for which I am firmly convinced there is a definite need.

All of the six records in Fig. 1 are taken from a survey in the same well. In addition, the three records on the left side of Fig. 2 are from the same survey. These nine records suggest a means for improving velocity-survey data and one which may not generally be recognized.

It can be seen that the signals recorded by the well phone can be correlated at all depths below 1,100 ft. The correlation is not as clearly shown in the figures as it would be if the records could be laid down one upon another; however, I think you can see that there is a marked similarity in the signal recorded at successive positions of the well geophone. Records shot from two holes on opposite sides of the well with the geophone at 2,600 ft. show remarkably similar signals. Most of the records in this survey correlate to a satisfactory degree and thus the problem of working up the survey is not materially different from that of correlating reflection records.

Note that in correlating these records the initiation of the signal through the earth is not always the first impetus on the well phone trace. For example, the records at 1,600 ft. and 2,100 ft. Note also that in order to correlate these records, it is necessary to record at least one trace at a relatively low amplification. Had this not been done and had reliance for correlation been placed strictly on the initiation of energy in the well phone, serious errors would have entered into the survey.

Cable kick . . . A plot of the initial breaks shows a nearly constant speed of approximately 11,500 ft. per second for the position of the well phone down to 2,100 ft., whereas the correlated signals show a time depth function which is more reasonable for the area. It is known that the speed of an elastic wave in the Schlumberger cables now in use is approximately 11,500 ft. per second and it is reasonable, therefore, to construe that the first impetuses which show this speed have been caused by signals transmitted from the shot point through the earth to the Schlumberger cable, thence down the cable to the well phone and are of no value in measuring the speed of the geologic column. Note also that the direction of kick for this signal is indeterminate. Records 1 and 2 show that the first impetus may be in either direction and this is verified by suspending a well phone and striking the cable with a hammer. Thus polarity is no criterion for identifying the initial impetus.

What Records Teach

The lessons to be learned from these records are:

1. Record the well survey at several levels of amplification, making certain that one level is sufficiently low to see clearly the complete signal.

A very common mistake made by operators unfamiliar with cable kick is to raise the gain to the point where the signal cannot be recognized and there is left only one of the means for identifying cable kick. The records in Fig. 2 illustrate this quite well. The two records on the right-hand side show observations with the gain adjusted so that the cable kick, which is normally weaker than the signal through the earth, is distinguishable from the signal through the earth in some cases and in other cases illustrate quite clearly had only high gain records been recorded, serious errors might have entered into the velocity survey.

2. Attempt to correlate the signals.

Eliminating Cable Kick

The foregoing assumes that cable kick is an unavoidable evil and suggests precautions to be taken in the conduct of the survey to make the cable signal and the signal through the earth both discernible. However, it would be much better to eliminate the cable signal entirely.

We know of three things to do:

1. Shoot the well survey from holes at a considerable distance from the bore hole. This will reduce, though not entirely eliminate, cable kick. It has the disadvantage of introducing large cor-

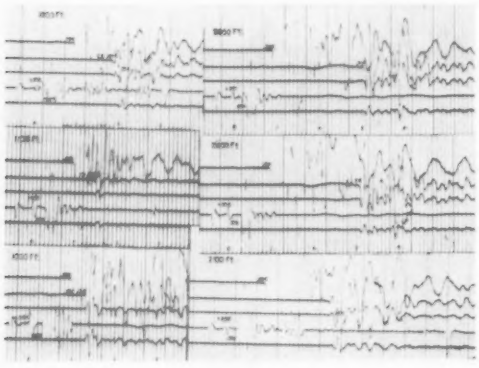


Fig. 1

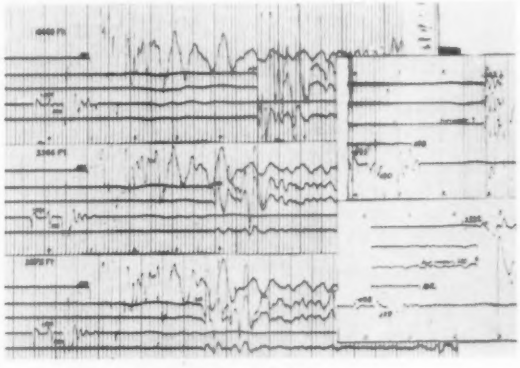
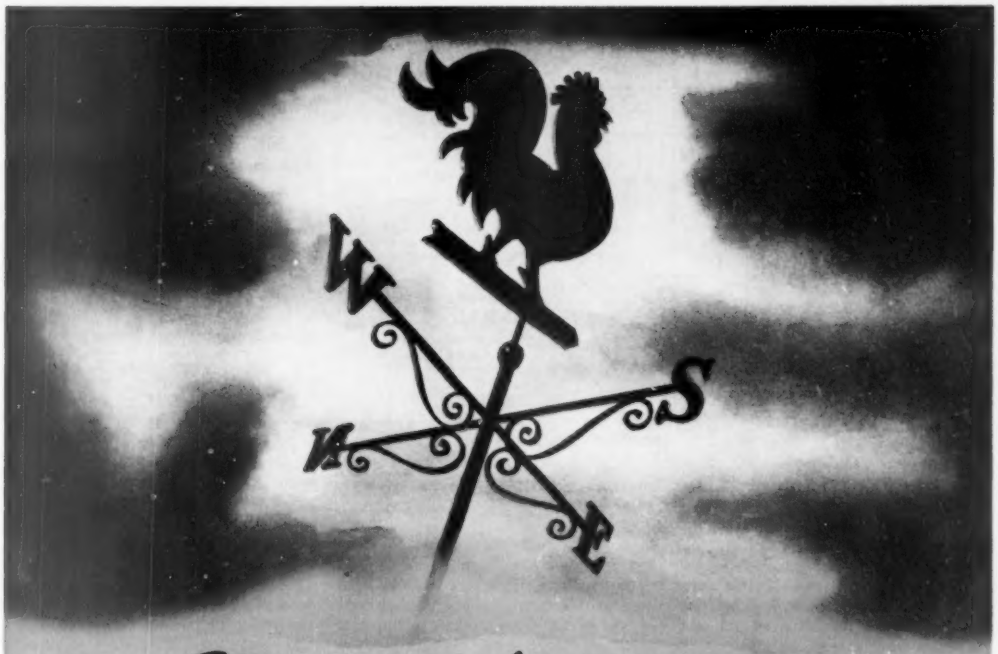


Fig. 2

Eleven velocity survey records illustrating source of error caused by cable kick. Low amplitude trace permits correlation of wave through the earth.



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rections in the survey in order to refer the observed times to vertical.

2. Filters have been designed to suppress or entirely eliminate the signal transmitted down the Schlumberger cable. We have such equipment in service and it consists simply of a 12-ft. section of heavy rubber hose at the base of which is attached the well geophone. This equipment has been used in a number of surveys and in all cases the cable kick has been eliminated.

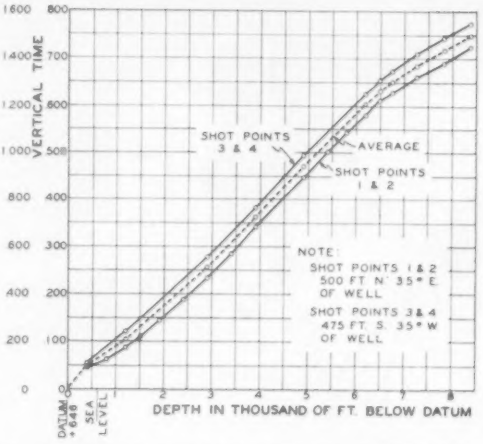


Fig. 3—Time-depth curve showing differences in arrival times from shot holes on opposite sides of well.

3. Pressure detectors are being developed which are relatively insensitive to cable kick and accordingly can be used quite satisfactorily in some surveys. Our experience is that they are as yet not completely satisfactory.

Time-Depth Curve

Fig. 3 is the time-depth curve from another survey in an entirely different area. Observations were made in this survey at intervals of a few hundred feet all the way from a depth of 500 ft. down to the total depth of the well. In this area the speed of elastic waves in the Schlumberger cable is less than the speed in the earth, consequently cable kick is no problem.

Note that two time-depth curves from the depth of 500 ft. down to total depth were obtained. These two curves have approximately the same shape, but the measured time at each level differs by a roughly constant amount of approximately 40 to 45 milliseconds down to approximately 7,000 ft. below which they deviate a little more.

One curve is obtained from a shot point on one side of the well, the other curve from a shot point on the opposite side of the well. The records are good and the observations are considered reliable. There is thus indicated in this survey a marked difference in the speed of a near surface section well below the base of the weathered layer, between the depth of 500 and 1,300 ft.; in a horizontal distance of 1,000 ft.

This high-speed zone was recognized only because closely spaced observations in the near-surface portion of the well were made and because observations were made throughout the survey at all levels from holes on the opposite sides. Had observations been made, as is often the practice, at only a few levels from holes on opposite sides it might have been construed that the hole had deviated from the vertical and that this accounted for the marked difference in the measured times. However, since observations were made at all levels and the difference remained reasonably constant, deviation of the hole is obviously not the explanation. The proposed alternative, a marked difference in speed in the near-surface section, is the more reasonable.

The value of such knowledge in the conduct of a seismic survey is obvious. The lessons to be learned from this survey are:

1. Shoot all surveys from at least two holes on opposite sides of the well.

2. Take observations at reasonably short intervals, preferably less than 500 ft.

3. Make observations throughout the entire length of the bore hole.

Summary

In order to improve the utility of velocity survey data, it is important to:

1. Eliminate cable kick by use of improved equipment; or, if such equipment is not available, to record a survey in such a manner that the cable kick can be separated from the signals through the earth.

2. Record the well geophone signal at several levels of amplification, at least one of which is low enough to see the entire signal and thus make use of the correlation technique, if possible, in picking the records.

3. Shoot the survey from at least two holes preferably equidistant from the well and on opposite sides.

4. Make observations at reasonably closely spaced intervals and throughout the full length of the bore hole.

How to Improve Quality Of First Breaks

by Neil R. Sparks

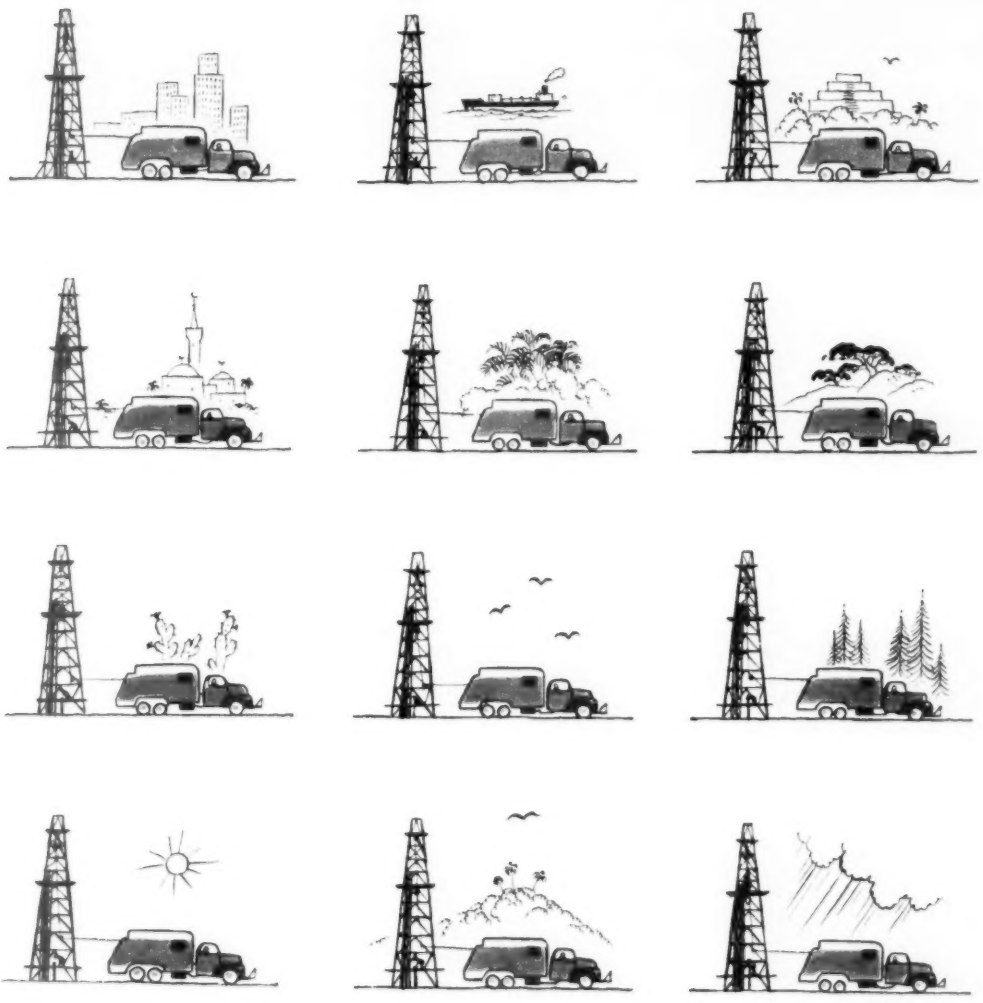
IN well shooting, as in no other part of our seismic work, our attention is centered upon first arrivals and, therefore, we are primarily interested in recording the very best first breaks possible.

In defining a good first break, I believe we can all agree that it is one which is clearly discernible above background noise and its time of arrival can be accurately picked on the record. But some will disagree on what is the best first break.

Judging from the records many "well shooters" submit, they believe that the best first breaks are obtained by increasing the amplifier gain so that the well-seismometer trace disappears at first break. This certainly makes the first break more discernible above the background noise and more accurately pickable to a "small" thousandth. However, I believe such excessive amplitudes detract from, rather than improve, quality of results.

Quality Detriments

First, we know that the time of first break depends upon the relative amplification. This was demonstrated by Dr. Ricker in his paper, "The Form and Laws of Propagation of Seismic Wavelets." The first break shifts to earlier and earlier time as the amplification is increased so that it is a losing battle in trying to record that elusive "true" first break by higher and higher amplification.



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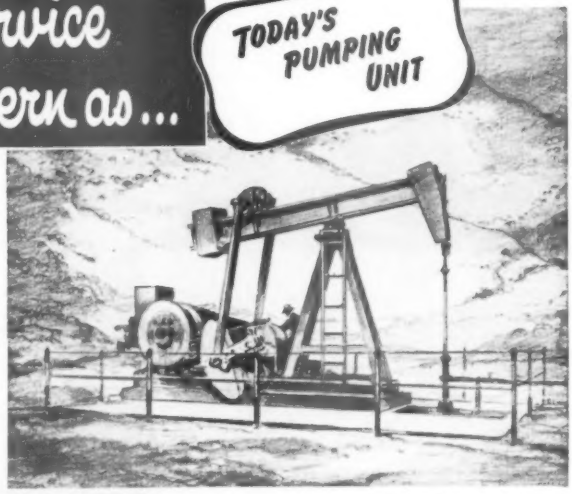

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A second detriment to quality of well-shooting data due to excessively high amplitudes is that part of the available information is being thrown away. This information is the character of the first-break energy; amplitude ratios and period of the first few oscillations of first-break energy. Character is just as important in determining the proper phase point to pick for first breaks as it is for proper picking of reflections. We certainly would not rely upon only one phase point in picking reflections as we would try to do on excessively high first breaks.

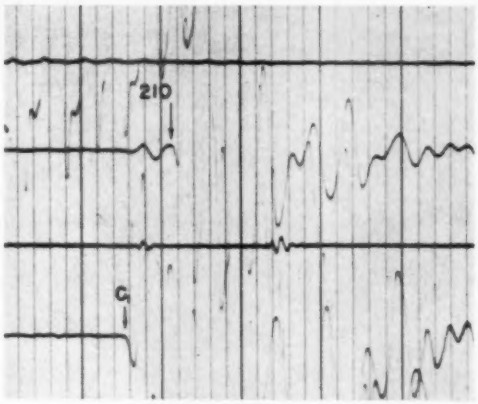

Fig. 1—Sample well-shooting record showing example of cable break swamping the formation break.

A third and more insidious detriment of excessively high first breaks is that the first arrival on the well-seismometer trace is not necessarily the wave through the formation which we seek. It may be a casing or cable break which is so bothersome in areas of relatively low formation velocity. In such cases we would certainly not improve results by allowing the trace to break off the record at first break. That would do about as much good as timing a horse race to the nearest millisecond when the dust was so thick you couldn't tell whether or not your horse was in the money. Often our money is on our horse to place.

Illustration . . . An example of cable break swamping the formation break is illustrated in Fig. 1. Both traces shown are fed by the same well seismometer. The upper trace at low gain shows the formation wave picked up at 210 and the lower trace, at approximately 10 times higher gain, shows the cable break as the first break picked at C. Even at the relatively moderate gain of the lower trace, the formation wave is completely hidden. If the amplifier gain had been increased on all shots so that the trace disappeared at first break, evidence of the erroneous first-break pick would have been lacking and a rational-appearing, smooth time-depth curve would have been obtained but which would have velocity 10 to 15 per cent too high. Such a large error could go undetected in a virgin area where no other velocity surveys were available for comparison.

Suggestions

So far I have been speaking in the negative sense—what shouldn't be done and what is done wrong. I would like to conclude this talk with the positive—what should be done to improve the quality of well-seismometer first breaks.

Adjust the amplification such that the wave form is clearly visible on the record for at least 0.1 second after first break. This can be accomplished on most records by using multiple-trace recording of the well-seismometer output at different gains, the lowest gain trace adjusted to meet this amplitude requirement.

In most cases two-trace recording with a gain ratio between traces of 8 or 10 to 1 will be entirely adequate. This ratio is well within the limits for which we can satisfactorily measure record amplitudes and is large enough to insure a minimum of repeat shots when the gain settings of the amplifier and/or charge size are inadvertently chosen incorrectly.

Time-Measurement Problems

by J. E. Owen

IN some areas an effect commonly known as shot-hole fatigue results in time variations associated with the initiation of seismic impulse.

Such variations also will adversely affect seismic data obtained in usual day-to-day exploration, particularly when repeated shots are taken in the same hole.

Figs. 1, 2, and 3 were prepared from data obtained on the velocity survey of a well near Hattiesburg, Miss., in 1946.

Shot-Hole Fatigue

1 Here successive shots from 10 to 20 lb. were fired at gradually decreasing depths from 72 to 50 ft. There was some variation in uphole time. Beginning with the ninth shot, however, the charges were placed somewhat lower in the hole and the observed time lengthened appreciably.

No measurement was made on the seismic impulse traveling downwardly from the shot. There is, however, no reason to believe that the upho'e-time measurement gives a satisfactory shot-hole fatigue correction.

When it was necessary to abandon shot hole No. 134, the next charge was placed in No. 134-A.

2 Most of these shots were placed at the same depth. In spite of this, however, the uphole time after the first four shots increased rapidly. Most of

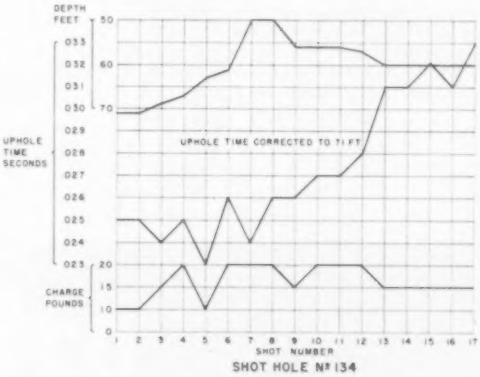

Fig. 1—Chart showing variation in uphole time as a result of shot-hole fatigue.

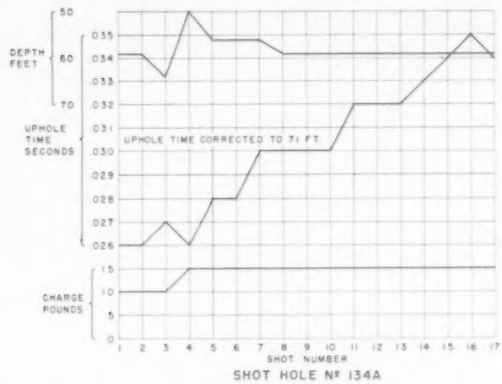

Fig. 2—More carefully controlled evidence of same effect as in Fig. 1.

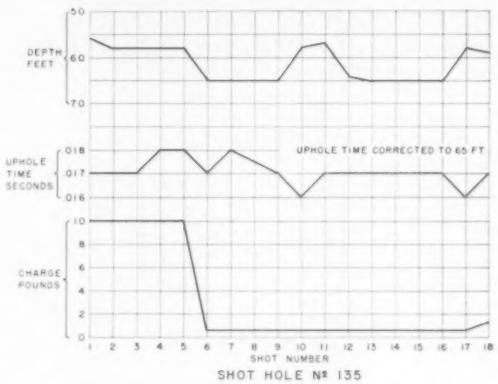

Fig. 3—Chart showing decreasing effects of fatigue by using smaller charges.

these charges were 15 lb. In this case there is no reason to believe that shot-hole fatigue was not also present for the downwardly traveling wave, although there is no good basis for making a correction for it.

3 This shot hole was approximately 400 ft. from the previously used shot holes. The well geophone was not at great depths by this time, and by shot No. 6 it was possible to reduce the charge to ⅝ lb. The large charges previously used were necessary in order to clean out the hole. A 2 to 5-lb. charge would have given sufficient energy but could not be used because it might cause the shot hole to bridge. It was possible to shoot ⅝-lb. charges almost indefinitely, however, without danger of losing the shot hole. The interesting thing about this illustration is the constancy of the uphole time.

It is not meant to imply that shot-hole fatigue such as has been observed here is the normal thing except in certain areas. Where it is found to exist, however, steps should be taken to correct for it. Large-diameter shot holes will reduce bridging effects, and thus allow the use of smaller charges. Although it adds to the expense of the survey, a geophone can be placed below the shot in a hole drilled for this purpose, and corrections for shot-hole fatigue can thereby be made. Time errors of the kind just shown can thus be reduced and the data corrected.

For purposes of correcting well velocity-survey data, a reflection can be picked on the records normally made of each shot from surface-planted geophones.

Other Problems

Illustrations showing some effects more difficult to understand and to do anything about are shown in some additional figures.

4 Here are tracings of well geophone records from a velocity survey in northern Oklahoma. In each case shown in this and in other figures at least two shots were taken, and the character of the recording repeated in good fashion. Notice here that at 5,580 ft. the first arrival of energy is shown as a down break. The instruments were so polarized that this corresponds to a downward motion of the geophone case.

At 5,000 ft., however, the first break is up, and, as has been pointed out, the repeat record was practically identical with it, showing that this is truly the way the geophone case moved. First breaks for geophone positions above this are normal. The reason for this abnormal break is not clear. The interval velocity data show that this abnormal break occurs at the top of a high-velocity section, suggesting that by some path energy may be reaching the well geophone from below before the

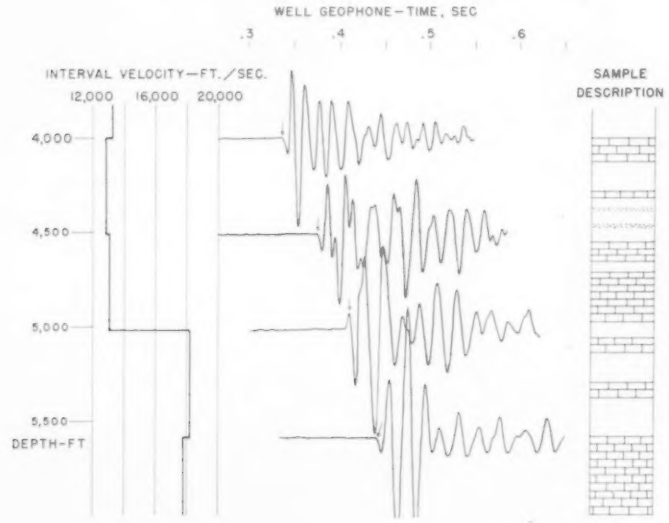

Fig. 4—Tracings of well geophone records from Champlin 1 Schribner, Woods County, Oklahoma.

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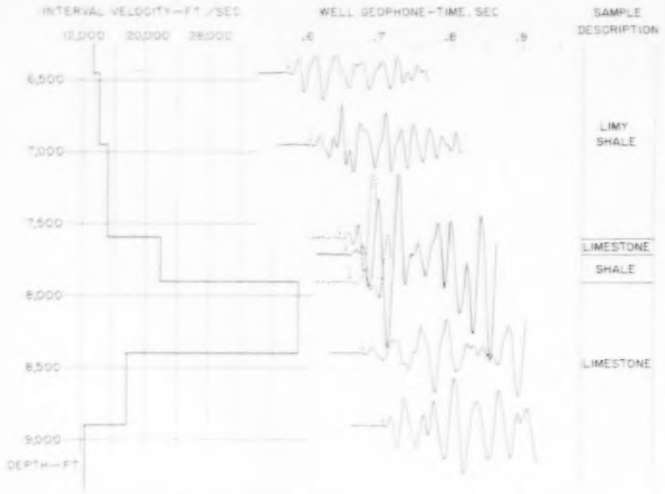

Fig. 5—Series of well geophone records from a velocity survey in Amerada 1 Rowland, Stevens County, Oklahoma.

downwardly traveling wave hits the geophone from above.

5 This is a series of well geophone records from a velocity survey in southern Oklahoma. The first arrivals here are poor in quality.

Geophone positions at 8,900, 8,400, and 7,900 ft. were taken. The interval velocity between 7,900 and 8,400 ft. was so absurdly high (3,900 ft. per second) that two nearby geophone depths were used. The anomalous results were obtained at the top of the Hunton limestone section, and where the interval velocities dropped. This well was a wildcat, and information obtained since the survey was made indicates faulting present. Hindsight suggests the well should have been shot from more than one direction.

6 Here are first breaks from the well geophone records from a velocity survey in Louisiana. Breaks were normal up to the 6,000-ft. position. Here a small upbreak is observed. The 5,500-ft. record has a poor first break. The observed time from the pick to the first trough on the record is greater than for the deeper geophone positions. The geophone was therefore moved to a nearby position, 5,350 ft. The record character here is very poor. The geophone was next lowered to 5,650 ft., and a poor first break was again obtained. Repeat records in each case showed the same first-break character. There is a zone from 5,350 to 6,000 ft. for which the record quality is poor. This is in a shale zone, a part of which is low velocity, and the trouble occurs at or near a change in interval velocity, again suggesting that the paths may not be direct for the first arriving energy.

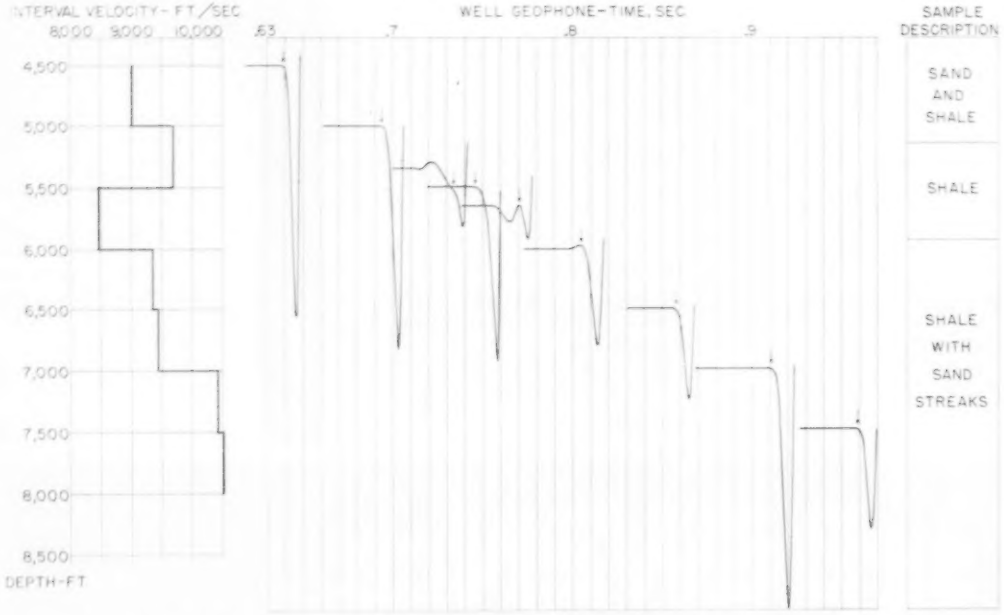

Fig. 6—First breaks from well-geophone records from Sid Richards on 1 Weil, Rapides Parish, Louisiana.

How Much Control Is Needed?

by Francis H. Cady

THE science of seismic interpretation is directly dependent upon well velocity surveys for some of its most useful basic data.

The ultimate in seismic interpretation is an accurate structure map of some specific geologic horizon, with depths expressed in feet below or above some arbitrary datum. But, unfortunately, seismograph records neither record depths in feet nor identify the reflections with specific horizons. They only record the times of arrival of a series of reflection events. It is in the conversion of these times to their correct depths and appropriate horizons that basic velocity data are invaluable. And the most accurate way of obtaining these data is by running a well velocity survey, in which a geophone is lowered down the hole, and the time required for seismic energy originating at the surface to reach it is measured directly.

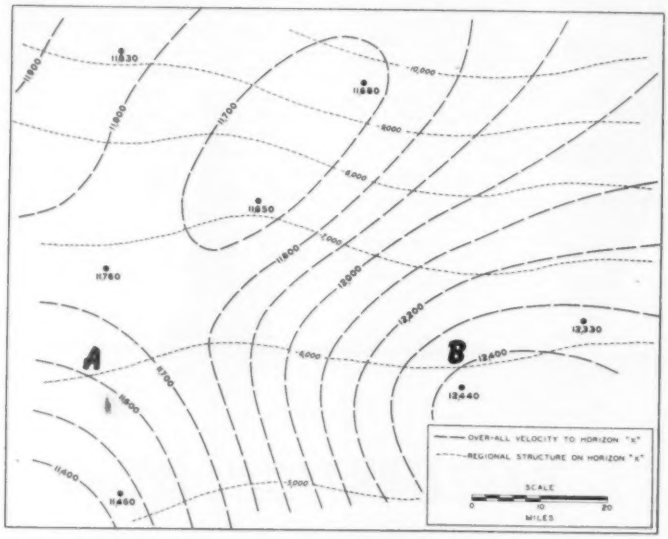

Fig. 1—Preliminary velocity map showing over-all velocity contours to and regional contours on horizon "x."

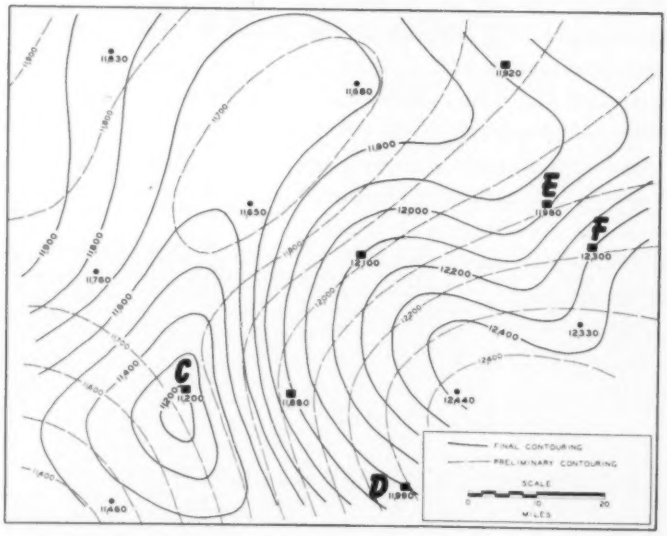

Fig. 2—Completed velocity map showing preliminary over-all velocity contours and final velocity contours on horizon "x."

If velocities were constant, a few such surveys would suffice to identify prominent reflections and to supply the data needed to make accurate time-to-depth conversions. But with the accumulation of more and more data, it has been found that lateral variations in over-all velocities are far more pronounced in many areas than was originally suspected. In these areas particularly, the number of velocity surveys should be increased until the pattern of such regional variations is established beyond the shadow of a doubt.

What density of control would this require? Obviously, the necessary density varies with the subsurface conditions causing the velocity anomaly. There are some areas in which velocity control points spaced several to a township were responsible for the recognition of extreme irregularities which were causing anomalous structures on time maps. In other areas, conditions seem to be so uniform that one survey for every four townships (more or less) is apparently sufficient. **As far as I am concerned, we will not have enough well velocity surveys until every seismic interpretation ties every available well, and accurately predicts the depths of future wildcats in the area.**

Another factor which I feel we should consider briefly, is the effect of diminishing returns in our exploration effort on the need for more well velocity surveys. Oil is becoming more difficult to find! This fact is forcing us to reevaluate our geophysical work and to demand higher standards of accuracy. Where we were content 5 years ago to combine a few facts with a great many assumptions, now we must insist on more facts and fewer assumptions. This, I believe, is a fundamental issue, general recognition of which is responsible for the interest now being shown in obtaining and analyzing velocity data. If we are to make progressive improvement in our accuracy of interpretation, we must utilize every bit of basic data which is obtainable; and this will certainly require the promot-

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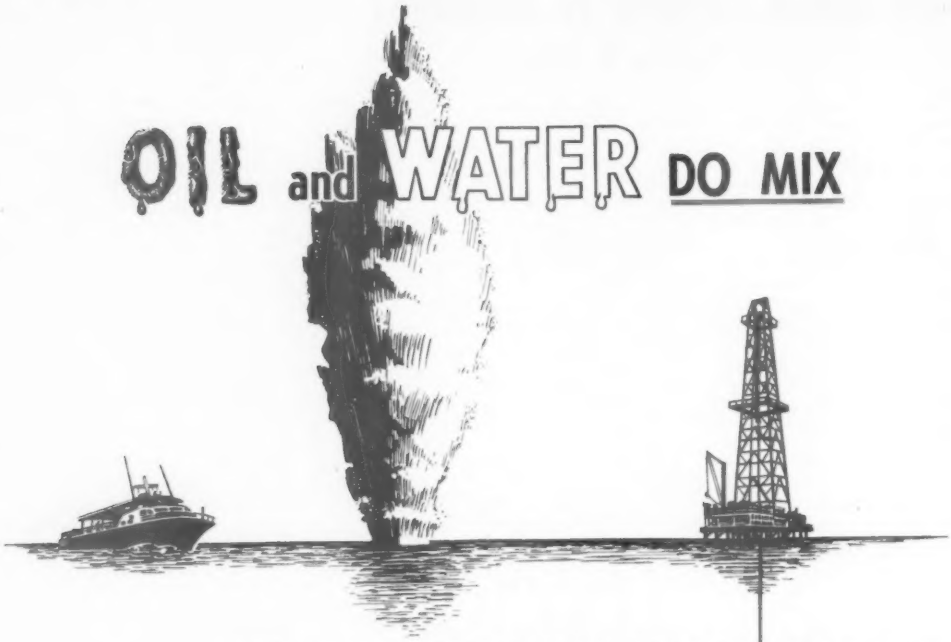

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ing of more velocity surveys in all areas where velocity irregularities are suspected of occurring.

Case History

Here's an example which illustrates the point I am trying to convey:

A certain company engaged in the business of finding oil had been conducting a seismic program in a certain area with rather dubious success. Reflection quality was not too good, with poor continuity and even poorer character. Some subsurface control was available; and before long it appeared as though the seismic map was not agreeing with the subsurface as well as should be expected. Before laying all the blame on miscorrelations, it was decided to investigate velocity conditions as shown by scattered well velocity-survey data. This what was found: (See Fig. 1). The regional subsurface contours were very regular, but the over-all velocity to the same horizon, as determined by seven fairly evenly distributed velocity surveys, was extremely irregular. It was obvious at once that our reflection time values could not be expected to tie the subsurface in this area without a regional velocity adjustment. Because of slower average velocity, a time value at point A is .060 greater than it is at point B, although at both points, horizon "x" is at the same depth.

A few years later it was decided to bring this study up to date with the addition of data from seven more surveys which had become available. (See Fig. 2). The seven original points of control are shown by large circles. The seven new points of control are shown by squares. The final contouring obtained by using data from all 14 wells is shown with solid lines, and for comparison, the preliminary contouring shown in the first figure is repeated with broken lines. The changes in contouring which were made after the addition of the new data can be compared directly in this figure. The greatest change was at C where the actual over-all velocity was 500 ft. per second slower than had been contoured originally. The velocity at D was missed by 300 ft. per second. Another significant change in contouring occurs between points E and F where the measured velocities missed the preliminary contouring by only 100 ft. per second, but in opposite directions, indicating a much steeper velocity gradient here than had been previously contoured.

It is doubtful that everyone will attach the same significance to these maps. To me, however, they mean that we do not yet have sufficient basic velocity data for the area. Further irregularities would undoubtedly be found by additional surveys; and a revised interpretation, based on the new data, could point to the location of a new oil field.

Value of Velocity Surveys

by Paul L. Lyons

A STUDY of the literature shows that one of the principal emphases in the subject of velocity surveys is on the need for more surveys. I believe that we should pause to evaluate velocity surveys, and in the course of this evaluation, to inquire if the investment in additional surveys is being repaid by the data gained.

Perhaps it is even time for a discouraging word, which, incidentally, is seldom, if ever, heard.

A velocity survey does at least three things. It (1) identifies reflections, (2) identifies over-all velocities, and (3) defines interval velocities. These are extremely worth while and necessary.

Now, what does an additional survey accomplish? Let us say that there are four surveys in a county, and it is proposed to establish a fifth. What good does it do?

I doubt that the additional survey does any more to identify reflections. The reflections in the county are pretty well identified by the first four surveys. Also, a very excellent job may be done on identifying reflections by close comparison of the reflection pictures with geology.

The new survey does give you an over-all velocity to any selected horizon or level, and this is a value which is always different from the other values on the other four surveys.

The new survey gives you some more interval velocities. In most cases, I wish to point out, they conform pretty well to those established in the other tests and conform to Faust's law in the matter of depth, assuming that the age of the intervals chosen does not vary.

We come to the conclusion that the main addition has been another point on a velocity overlay. If a conventional velocity overlay is the objective, i.e., a map showing the over-all velocity to a given reflection horizon, then I do not believe that we have helped ourselves enough to merit the cost of the survey.

I say this because a velocity overlay, unless it be to a very shallow bed, is a sorry way to calculate depths. If a section involves several unconformities, and a number of diverse sedimentary beds, then a measure of over-all velocities is equivalent to weighing a bushel of mixed vegetables. If the measure is done at all, it should be done by groups of vegetables involved if we wish to

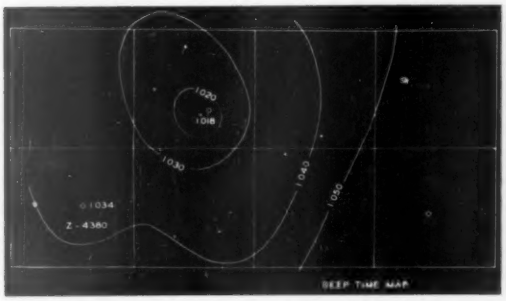

Fig. 1—Seismic anomaly in reflection times on Ordovician horizon. High point should be near time of 1.018. Grid is in square miles.

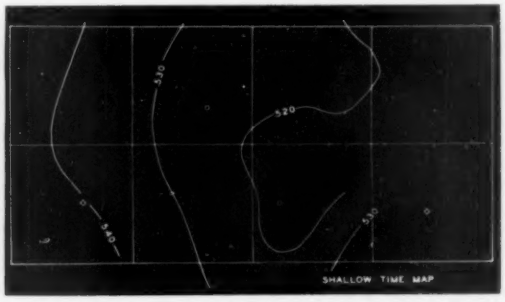

Fig. 2—Seismic anomaly is shifted eastward on a shallow Pennsylvanian seismic time map.

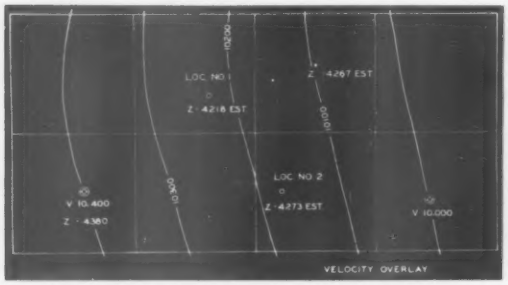

Fig. 3—Velocity overlay provided by close control—two tests 3 miles apart. The times of Fig. 1 allow prediction (?) of depths for any location.

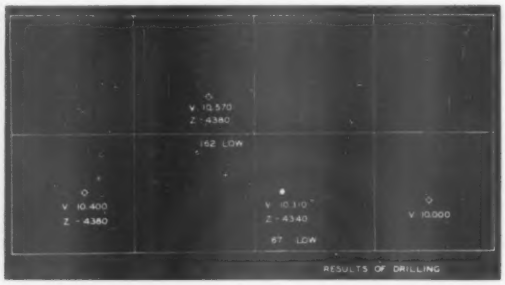

Fig. 4—The sad result of misplaced trust in velocity overlays. More velocity surveys will not prevent such catastrophies, but proper computing will. Note the unique but predictable over-all velocity at each well.

predict the weight of the next bushel of mixed vegetables.

I am also quite sure that the true over-all-velocity picture to a given horizon, where unconformities are involved, is more complex than the subsurface structure we seek to define. To some extent, it is true that a very generalized over-all-velocity picture will help us make a first approximation to the structure.

I can illustrate all of this by an example. This example is not an unusual case. Since it appears that perhaps four out of five small seismic anomalies may not be true structures, although defined as such, my example may be more the rule than the exception.

By way of warning, I should like to say that a time anomaly, like a gravity or magnetic anomaly, need not coincide with a structural anomaly in position. As a matter of fact, in many cases they should not coincide.

Fig. 1 shows a fine seismic anomaly —an actual case—a nice dish to set before any management. Please observe the east dip which is reversal in the area, and there exists more than .032 seconds of reverse dip. The center of the target for drilling is .016 seconds higher than a dry hole with shows of oil. What are we waiting for? This deal should be drilled. However, it is only fair that we should apply some science to this business. Perhaps we shouldn't drill time anomalies. Incidentally, there were more than 50 shot stations on this map. The area was plastered with them. All were continuous profile. All records had excellent reflections. All were corrected to the same frequency. They were corrected for hi'ls (load factor). There were no final troubles at all—as evidenced by the smooth contours.

A slight sour note is introduced by a shallow map, Fig. 2. The top of the shallow high simply is not where the deep one is. It is now necessary to get a geologist to explain this. We find that the deep high does not necessarily coincide with the shallow high, and of course this is true and may be demonstrated. Nevertheless, there is a fly in our ointment, and maybe no oil in it.

But what are we worried about? We have two ve'ocity tests only 3 miles apart. I submit to you that that is about as close a spacing as you can ask for —100 per cent of the wells have velocity data available. It is time to use our rubber yardstick, the velocity overlay. The velocity overlay supposedly cures everything. I've even heard it said that it takes care of miscorrelations.

A velocity overlay is shown in Fig. 3. The man who worked this job noted the change from 10,000 to 10,400 ft. per second to the Ordovician horizon, and said that velocity variation exists. Furthermore, he said that it is normal velocity variation, with the velocity to a given bed decreasing up the regional dip.

We come face to face with the first dilemma, faced time and again in every velocity overlay. What does the anomaly of Fig. 1 do to the overlay? Since the reflecting bed is perhaps nearer the surface at the top of the time anomaly, is the velocity less over the anomaly?

Well, if it is less, then the structure is bigger than we think. Maybe the velocity is greater over the structure, as shown by the time map, due to compaction effects. This would hurt, for then the reflection horizon would be deeper. We don't know the answer to these questions, so we get conservative, as we knew we would get, and draw the ve'ocity contours smoothly. Practically everybody does it this way. While we are doing it, we wonder if there might not even be a velocity halo effect.

All the time, however, we are fortified by the thought that we have enough time anomaly to take care of practically anything. We even predict that there is at least, conservatively, 50 ft. of structure. We put down some numbers. We do all this, I say, if we're not sharp, if we're not alert. If we are alert, we can call these wells within a few feet, and without a velocity overlay, and without a survey. Actually, there is no real velocity variation here.

We should have drilled the shallow time anomaly, because that is where the **real** structure lies at depth.

Fig. 4 shows what happened. The first location drilled by the people who discovered this was 162 ft. lower than predicted. The second test was 67 ft. lower than predicted by the velocity overlay. It made a small producer because it was on a small structure.

What is the answer? You have a four layer problem, essentially. Layer 1 is flat at the surface, and its base dips eastward (shown by the shallow map). Layer 2 has a higher velocity than layer 1, and thickens to the east. This is typical of Oklahoma Pennsylvanian beds. Layer 3 has a high velocity compared to layer 2, and thickens to the west appreciably, and thins over the small structure. (This is typical of Oklahoma Ordovician in some areas.) The deep reflection comes from the top of layer 4.

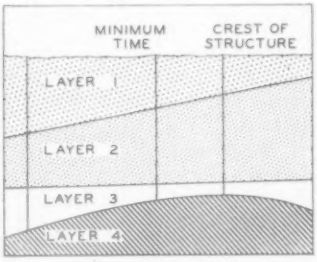

Fig. 5.

If this were a refraction problem, the layers would all be tagged with a

constant velocity for each, and the attitude of the beds solved, as in Fig. 5. Velocity variation would not be mentioned—only thickness variation. If you do the same thing using reflection times and fairly constant velocities for the individual beds, then in this situation the deep high shows as a small one right below the shallow high. Incidentally, the correct over-all-velocity overlay can be derived **after** the structure is derived. You don't need it by that time.

Anyway, how you correctly compute this is not quite in the province of this demonstration. The point to be discussed is, how many velocity surveys do you need to do an accurate job of computation?

I say that it does not hurt to have velocity surveys on all the wells. But:

1. Over-all-velocity overlays won't do the job. Velocity overlays for sedimentary units will.

2. Mathematical velocity functions involving over-all time and depth functions won't do the job. (Don't misunderstand—I think Faust's function is excellent; it can be used on this job, but layer by layer.)

3. A good job in this case can be done without velocity tests, since the relationships are apparent by well ties and cross-sections.

4. Money is better spent tying to wells than on velocity surveys.

5. Finally, I say you can do a good job of computing without many or any surveys; i.e. you can get along without crutches.

In closing, I have one suggestion. If well B is tied by continuous profiling to well A, then well B has available what might be called a second-order velocity survey. I'm quite sure most of you will still insist that there is need for innumerable velocity surveys. Then we should calculate all these second-order surveys we can, put them in leather folders, and trade them around or sell them through the well-shooting associations.

Summation by Moderator

This panel appears to be in good agreement on the need for more velocity control and on the possibility of significant errors in present control. Although Paul Lyons may appear to dissent from the majority opinion, his main point, and an excellent one, is the suggestion that we make all possible use of existing data.

It may be concluded therefore that while awaiting more and better velocity control, the velocity specialist should consider the problems of facies changes and formation thinning as part of his stock in trade.

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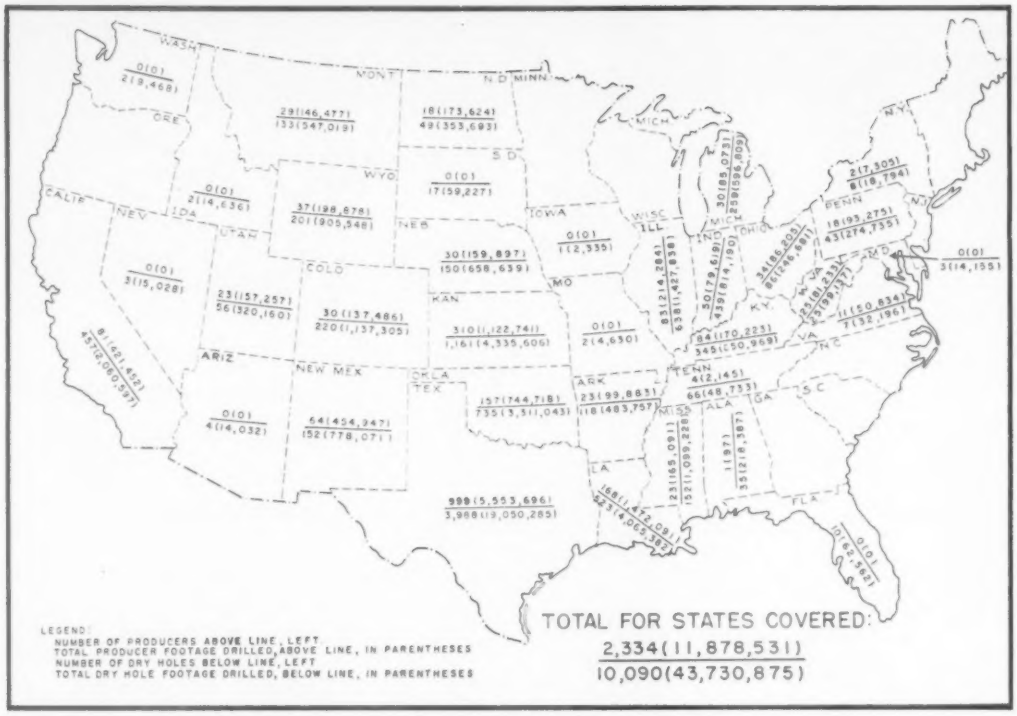


Fig. 1—Where hole was made in 1952 in the United States in the search for new oil.

1952 EXPLORATORY DRILLING . . .

Wildcat Score: 12,424 Holes—2,334 Wells

Majors drilled 1,286 new-field wildcats, 217 being producers. Minors and independents drilled 4,912 new-field tests, with 487 being completed as producers

by Frederic H. Lahee

This abridgement of the report of the chairman of the American Association of Petroleum Geologists' Committee on Exploratory Statistics, presented at the association's annual meeting in Houston, March 23-26, is published by special permission of the author and the A.A.P.G. The full report will be published in the June bulletin of the A.A.P.G.

Lahee, who is geological and research counselor for Sun Oil Co., Dallas, was the recipient of the Sidney Powers Memorial Medal, awarded by A.A.P.G., as reported elsewhere in this issue.

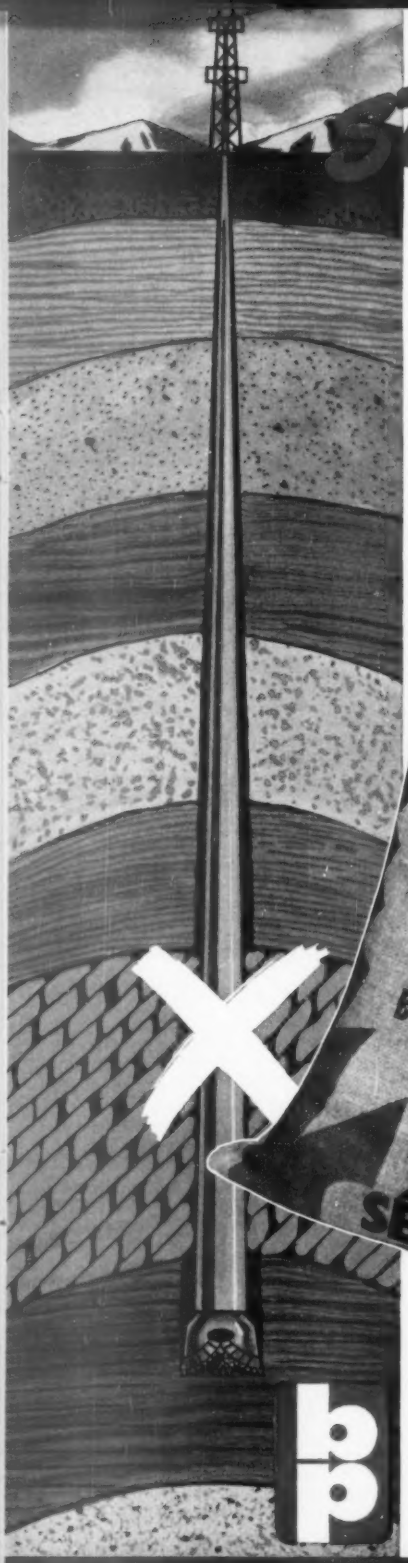
IN the states covered in this review, as shown in Fig. 1 and listed in Table 2, during 1952 a total of 55,609,406 ft. was drilled in 12,424 exploratory holes, divided as follows:

2,334 producers	11,878,531 ft.
10,090 dry holes	43,730,875 ft.

This means that 18.78 per cent of the holes drilled, and 21.36 per cent of the footage drilled, were successful in 1952. One producer foot was drilled for every 3.68 ft. of dry hole. One successful well was drilled for every 4.32 dry holes. The average depth of hole was 4,476 ft.

Attention is called to the average depth figures for the various producing classes and for dry holes, and totals, at the bottom of the footage columns in Table 2.

Bases for drilling . . . In Table 3 are listed the reasons for drilling the new-field wildcats in 1952, by using the best information available from men familiar with such statistics, each in his own state or district. According to these figures 680 new-field wildcats drilled on technical advice (geology and/or geophysics) were successful, and 4,818 were dry; 16 holes, located for nontechnical reasons, were producers, and 466 were dry; 44 producers and 672 dry holes were located for reasons unknown. These figures show that 12.4 per cent of the new-field wildcats drilled on technical advice were producers as contrasted to 3.3 per cent successful in the case of holes located without technical advice. Therefore, in 1952, locations for new-field wildcats based on technical recommendations were 3.8 times as successful as those drilled without such advice. Seismographic methods were



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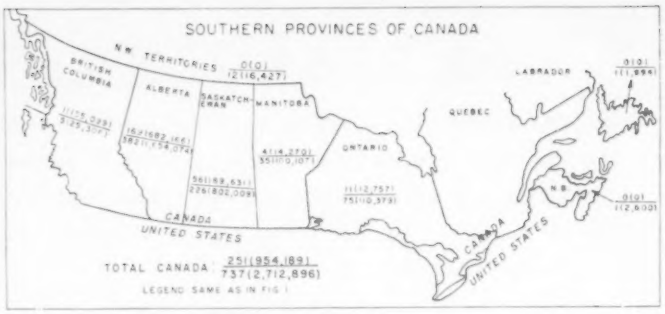

Fig. 2—Canada drilled 988 wildcats as shown here.

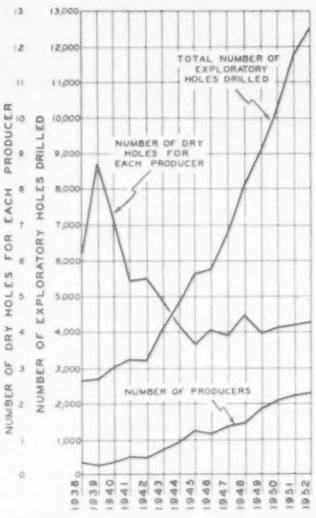

Fig. 3—Relative success of exploratory drilling in the United States from 1938 to 1952 inclusive.

largely responsible for 334 producers and 1,738 dry holes, among the new-field wildcats.

Table 4 shows the relative success, as measured by the number of producers in comparison with the number of dry holes, in each year from 1944 to 1952, inclusive. The same data for all exploratory holes are graphically shown from 1938 to 1952 in Fig. 3.

Classifications . . . As indicated in Table 1, a hole may be located as an outpost with the intention of trying to extend a pool partly developed, but instead it may discover a new pool; and, similarly, a new-pool wildcat may be located in search of a new pool because it is believed to be well outside the limits of the known pool, but instead it may result in extending this known pool farther than had been expected. A majority of outposts, if successful, are completed as extension wells and a majority of new-pool wildcats, if successful, discover new pools. During 1952, 582 outposts were completed as extension wells and 124 were completed as new-pool discoveries; and 452 new-pool wildcats discovered new pools whereas 98 new-pool wildcats were completed as extension wells. (The new-pool discoveries referred to here are all the result of exploratory drilling. In addition to these, at least 90 new pools were discovered in the drilling of field-development wells. These included 64 discoveries of oil, 16 of gas, and 10 of condensate.)

A question sometimes asked concerns the approximate percentage of true wildcatting (new-field wildcatting) by major companies, on the one hand, and by minor companies and independents, on the other hand. Distinction among three classes of operators is not always easy, and in some instances the same company may be regarded as a "major" in one district, but as a "minor" in another district.

In order to standardize the use of these terms in connection with these exploratory statistics, the committee drew up definitions more than a year ago, and in the present annual report it is adhering to them. *(See The Oil and Gas Journal, April 7, 1952.)*

Our statistics showed that in the country as a whole in 1952, 1,286 new-field wildcats (217 producers and 1,069 dry holes) were drilled by majors; 4,912 new-field wildcats (487 producers and 4,425 dry holes) were drilled by minors and independents; and 499 new-field wildcats (36 producers and 463 dry holes) were drilled by minors or independents with at least 50 per cent of the cost of drilling contributed by major companies.

TABLE 1—CLASSIFICATION OF EXPLORATORY WELLS

			I. *Classification When Drilling Is Started*	II. *Classification After Completion or Abandonment*		
				Successful		*Unsuccessful*
			A	*B*		*C*
Drilling for joint extension of partly developed pool			1 Outpost (Extension test)	1 Extension well (Sometimes a new-pool discovery well)		1 Dry outpost (Dry extension test)
Drilling for a *new pool* on a structure or in a geological environment already productive	New-pool tests	Drilling within limits of proved area of pool — For new pool *above* deepest pool	2a Shallower-pool test	New-pool discovery wells (Or sometimes extension wells)	2a Shallower-pool discovery well (Sometimes shallower-pool extension well)	Dry new-pool tests 2a Dry shallower-pool test
		Drilling within limits of proved area of pool — For new pool *below* deepest pool	2b Deeper-pool test		2b Deeper-pool discovery well (Sometimes deeper-pool extension)	2b Dry deeper-pool test
		Drilling outside limits of proved area of pool	2c New-pool wildcat		2c New-pool discovery wildcat (Sometimes an extension well)	2c Dry new-pool wildcat
Drilling for a *new field* on a new structure or in an environment never before productive)			3 New-field wildcat	3 New-field discovery wildcat		3 Dry new-field wildcat

Size of Discoveries

Some years ago we included in our annual report a table showing the number of fields discovered each year, from 1938 to the year preceding the year reported, these fields being grouped according to a rough estimate of their total ultimate reserves from the date of discovery. The fields were grouped according to these estimates: "A" meaning a total ultimate of 50 million barrels or more; "B," from 25 to 50 million barrels; "C," from 10 to 25 million barrels; "D," from 1 to 10 million barrels; "E," less than 1 million barrels; and "F," abandoned. Gas fields were not included unless they also produced oil or condensate. A few fields were omitted where satisfactory estimates were not readily obtainable.

In the present report, we are repeating our approach of the last 3 years. We are recording, in Table 5, estimated total ultimate reserves only for the discoveries of 1946, 1949, and

TABLE 2—NUMBER OF OIL WELLS, GAS WELLS, CONDENSATE WELLS AND DRY HOLES DRILLED IN THE UNITED STATES AS EXPORATORY TESTS IN 1952

State—	Oil producers		Gas producers		Condensate producers		Total producers		Dry holes		Grand total		Average depth of hole*
	No. of holes	Footage	No. of holes	Footage	No. of holes	Footage	No. of holes	Footage	No. of holes	Footage	No. of holes	Footage	
Alabama	1	97	0	0	0	0	1	97	35	218,387	36	218,484	6,069
Arizona	0	0	0	0	0	0	0	0	4	14,032	4	14,032	
Arkansas	21	95,701	2	4,182	0	0	23	99,883	118	483,757	141	583,640	4,139
California	69	367,142	12	51,310	0	0	81	421,452	457	2,060,597	538	2,482,049	4,613
Colorado	17	74,139	13	63,347	0	0	30	137,486	220	1,137,305	250	1,274,791	5,099
Florida	0	0	0	0	0	0	0	0	10	62,562	10	62,562	
Georgia	0	0	0	0	0	0	0	0	0	0	0	0	
Idaho	0	0	0	0	0	0	0	0	2	14,636	2	14,636	
Illinois	80	210,423	3	3,861	0	0	83	214,284	638	1,427,838	721	1,642,122	2,278
Indiana	45	71,699	5	7,920	0	0	50	79,619	439	814,190	489	893,809	1,828
Iowa	0	0	0	0	0	0	0	0	1	2,335	1	2,335	
Kansas	286	1,009,022	28	126,647	0	0	310	1,122,741	1,161	4,335,606	1,471	5,458,347	3,711
Kentucky	73	154,032	11	26,191	0	0	84	170,223	345	650,969	429	821,192	1,914
Louisiana	86	710,172	8	58,622	74	849,503	168	1,472,091	523	4,065,382	691	5,537,473	8,014
Maryland	0	0	0	0	0	0	0	0	3	14,155	3	14,155	
Michigan	27	77,721	3	7,352	0	0	30	85,073	259	596,809	289	681,882	2,359
Mississippi	18	134,851	1	3,164	4	27,076	23	165,091	152	1,099,228	175	1,264,319	7,225
Missouri	0	0	0	0	0	0	0	0	2	4,630	2	4,630	
Montana	27	141,326	2	5,151	0	0	29	146,477	133	547,019	162	693,496	4,281
Nebraska	23	129,532	7	30,365	0	0	30	159,897	150	658,639	180	818,536	4,547
Nevada	0	0	0	0	0	0	0	0	3	15,028	3	15,028	
New Mexico	48	346,628	13	70,288	3	38,031	64	454,947	152	778,071	216	1,233,018	5,708
New York	0	0	2	7,305	0	0	2	7,305	8	18,794	10	26,099	
North Carolina	0	0	0	0	0	0	0	0	0	0	0	0	
North Dakota	18	173,624	0	0	0	0	18	173,624	49	353,693	67	527,317	7,870
Ohio	8	16,837	26	69,368	0	0	34	86,205	86	24,681	120	332,886	2,774
Oklahoma	126	576,685	23	99,805	8	68,228	157	744,718	735	3,311,043	892	4,055,761	4,547
Oregon	0	0	0	0	0	0	0	0	0	0	0	0	
Pennsylvania	0	0	18	93,275	0	0	18	93,275	43	274,735	61	368,010	6,033
South Carolina	0	0	0	0	0	0	0	0	0	0	0	0	
South Dakota	0	0	0	0	0	0	0	0	17	59,227	17	59,227	
Tennessee	4	2,145	0	0	0	0	4	2,145	66	48,733	70	50,878	727
Texas	757	3,955,111	155	902,956	87	695,629	999	5,553,696	3,988	19,050,285	4,987	24,603,981	4,934
Utah	16	121,578	7	35,679	0	0	23	157,257	56	320,160	79	477,417	6,043
Virginia	0	0	11	50,834	0	0	11	50,834	7	32,196	18	83,030	
Washington	0	0	0	0	0	0	0	0	2	9,468	2	9,468	
West Virginia	0	0	25	81,233	0	0	25	81,233	25	99,137	50	180,370	3,607
Wyoming	29	139,181	5	21,913	3	37,784	37	198,878	201	905,548	238	1,104,426	4,640
Total U. S.	1,775	8,484,718	380	1,823,768	179	1,570,045	2,334	11,878,531	10,090	43,730,875	12,424	55,609,406	4,476
Average depth per hole		4,786		4,799		8,771		5,089		4,334		4,476	

*Average per well footage given only where 25 or more wells were drilled in a state.

1952. This is the fourth year in which we have attempted such an estimate of the fields discovered in the year just closed. Previously we allowed a year to elapse. The estimates in Table 5 were all made in January 1953. Those referring to discoveries in 1946 and 1949 were revisions, where revisions seemed necessary. In revising the earlier estimates for discoveries of 1946, as made in January 1950, one C was raised to B; two C's were lowered to D; seven D's were raised to C; four D's were lowered to E; two D's were lowered to F; one E was raised to C; eight E's were raised to D; twenty-one E's were lowered to F; and two F's were moved up to E. In revising the earlier estimates for 1949 (made in January 1950), one A was lowered to B; one C was raised to B; two C's were lowered to D; three D's were raised to A; two D's were raised to B; three D's were raised to C; fifteen D's were lowered to E; three D's were lowered to F; one E was raised to A; one E was raised to C; thirty-six E's were raised to D; and thirty-two E's were lowered to F.

It is our plan to make these estimates of the fields discovered in any given year only 3 years and 6 years, respectively, after their dates of discovery, with a rough preliminary estimate given just after their discovery. It is very doubtful whether the first estimates for the discoveries of the year just elapsed can be of much significance, for not enough is yet known of the various factors which should enter into an estimate of this kind.

Exploratory Drilling in Canada

In western Canada, in 1952, 900 exploratory holes were completed, 240 of these being producers and 660 being dry holes. The producers included 144 oil wells, 94 gas wells, and 2 condensate wells. A total of 3,539,355 ft. was drilled, 941,432 ft. in producers and 2,597,923 ft. in dry holes. This means that 28.66 per cent of the exploratory holes and 26.88 per cent of the exploratory footage were successful. There were 2.75 ft. drilled in dry holes for every foot drilled in producers. For every producer completed 2.75 dry holes were abandoned. The average depth of all the exploratory holes was 3,933 ft.

Among the 686 new-field wildcats completed in western Canada in 1952, 131 were successful and 555 were dry. In other words, new-field wildcatting was 19.09 per cent successful. One producer was drilled for every 4.2 dry holes.

In eastern Canada, 88 exploratory holes were drilled, with a total of 127,730 ft. Of the 88 holes 11 were successful, 8 as gas wells and 3 as oil wells, and all in southwestern Ontario.

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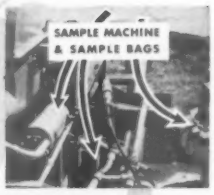

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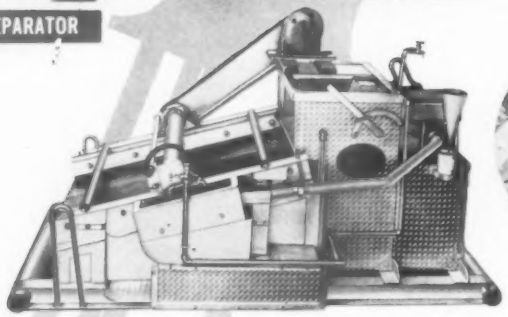

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TABLE 3—BASIS FOR LOCATING NEW-FIELD WILDCATS DRILLED IN 1952

State—	Geology		Geophysics*		Geology and geophysics		Sundry non-technical		Unknown		Total		Grand total
	Producers	Dry holes	Producers	Dry holes	Producers	Dry holes	Producers	Dry holes	Producers	Dry holes	Producers	Dry holes	
Alabama	0	20	0	8	0	1	0	3	0	1	0	33	33
Arizona	0	2	0	0	0	0	0	0	0	2	0	4	4
Arkansas	10	65	2	11	2	11	0	0	0	5	14	92	106
California	4	209	1	27	5	29	2	35	0	7	12	307	319
Colorado	1	42	14	130	1	10	1	33	0	0	17	215	232
Florida	0	8	0	1	0	0	0	1	0	0	0	10	10
Idaho	0	2	0	0	0	0	0	0	0	0	0	2	2
Illinois	20	210	2	11	0	5	0	21	0	2	22	249	271
Indiana	22	275	0	5	0	0	0	0	1	33	23	313	336
Iowa	0	0	0	0	0	0	0	0	0	1	0	1	1
Kansas	13	100	5	59	0	11	0	0	6	102	24	272	296
Kentucky	10	91	0	3	0	0	0	3	2	14	12	111	123
Louisiana	7	124	27	130	22	94	0	0	1	7	57	355	412
Maryland	0	2	0	0	0	0	0	0	0	0	0	2	2
Michigan	11	169	1	3	0	0	0	0	0	0	12	172	184
Mississippi	13	90	2	42	5	9	0	2	0	7	20	150	170
Missouri	0	0	0	1	0	0	0	0	0	0	0	1	1
Montana	3	47	2	29	5	5	0	8	0	9	10	98	108
Nebraska	17	5	0	79	0	1	0	58	0	4	17	148	165
Nevada	0	3	0	0	0	0	0	0	0	0	0	3	3
New Mexico	15	54	17	34	0	6	0	0	1	50	33	144	177
New York	0	3	0	0	0	0	0	2	0	3	0	8	8
North Dakota	0	7	0	17	4	3	0	6	0	0	4	33	37
Ohio	0	0	0	0	0	0	0	5	0	0	0	5	5
Oklahoma	22	154	10	75	3	3	0	0	8	104	43	336	379
Pennsylvania	0	14	0	0	0	0	0	2	1	7	1	23	24
South Dakota	0	4	0	9	0	0	0	3	0	1	0	17	17
Tennessee	1	52	0	0	0	0	0	0	0	8	1	60	61
Texas	172	1,104	90	431	92	486	13	251	24	304	391	2,576	2,967
Utah	1	31	2	8	0	5	0	6	0	0	3	50	53
Virginia	5	2	0	0	0	0	0	0	0	0	5	2	7
Washington	0	1	0	1	0	0	0	0	0	0	0	2	2
West Virginia	7	14	0	0	0	0	0	0	0	0	7	14	21
Wyoming	5	54	4	41	3	26	0	27	0	1	12	149	161
Total	359	2,958	179	1,155	142	705	16	466	44	672	740	5,957	6,697

*Includes three dry holes located by geochemistry.

TABLE 4—RELATIVE SUCCESS OF EXPLORATORY DRILLING IN UNITED STATES FROM 1944 TO 1952, INCLUSIVE

Year	New-field wildcats		All exploratory holes	
	No. of dry holes each producer	Percentage of wells successful	No. of dry holes each producer	Percentage of wells successful
1944	8.05	11.05	4.08	19.67
1945	7.63	11.59	3.62	21.64
1946	8.39	10.65	4.06	19.76
1947	7.80	11.32	3.90	20.34
1948	7.57	11.66	4.50	18.25
1949	7.79	11.37	3.95	20.20
1950	7.93	11.19	4.11	19.54
1951	8.05	11.05	4.30	18.86
1952	8.05	11.04	4.32	18.78
1944-1952, inclusive	7.70	11.47	4.13	19.50

TABLE 5—FIELDS* DISCOVERED IN 1946, 1949, AND 1952, GROUPED ACCORDING TO THEIR TOTAL ULTIMATE RESERVES AS ESTIMATED ON JANUARY 1, 1953

Year	Number of fields discovered in year indicated by reserves groups†						Total A—F inclusive	A + B + C fields	Percentage of A + B + C fields in total fields
	A	B	C	D	E	F			
1946	3	2	10	58	136	43	252	15	5.95
1949	6	5	6	69	275	36	397	17	4.28
1952	1	3	7	65	524	9	609	11	1.81

*This table refers only to the states of Alabama, Arkansas, California, Colorado, Illinois, Indiana, Kansas, Kentucky, Louisiana, Michigan, Mississippi, Montana, Nebraska, New Mexico, Oklahoma, Texas, and Wyoming. It does not include gas fields unless natural-gas liquids are produced, and then the reserves figure relates only to these liquids. A few fields were omitted because of inadequate estimates, and a few producing areas, at first thought to be new fields, have became consolidated with other fields.

†In this table, A means 50 million barrels or more, B means between 25 and 50 million barrels, C means between 10 and 25 million barrels, D means between 1 and 10 million barrels, E means less than 1 million barrels, and F means abandoned.

In these producers, 12,757 ft. was drilled. Of the 88 holes, 12.5 per cent were successful; 9.98 per cent of the exploratory footage was in successful holes. For every foot drilled in producers, 9.0 ft. was drilled in dry holes. The average depth of hole was 1,451 ft.

BOOK

GENERAL DISCUSSION OF HEAT TRANSFER. Published by the Institution of Mechanical Engineers, Storey's Gate, St. James' Park, London, S.W.1., England 496 pp. $10.

This volume provides a comprehensive review of a decade's developments in the mechanism of heat transfer, in design of apparatus relating thereto, of new fundamental discoveries in the field, and of methods of approach to heat transfer problems. Heat transfer with change of state and between fluids and surfaces; conduction in solids and fluids; convection, radiation, instrumentation, measurement techniques, and analogies; and special problems such as heat transfer in turbine-blade cooling, in liquid metals, in gas turbines and in piston rings, are concisely dealt with in its 93 papers. The papers were presented at a conference in London, September 1951, which was sponsored by the I.M.E. and the American Society of Mechanical Engineers, and which was continued at the 1951 A.S.M.E. meeting at Atlantic City in December 1951.

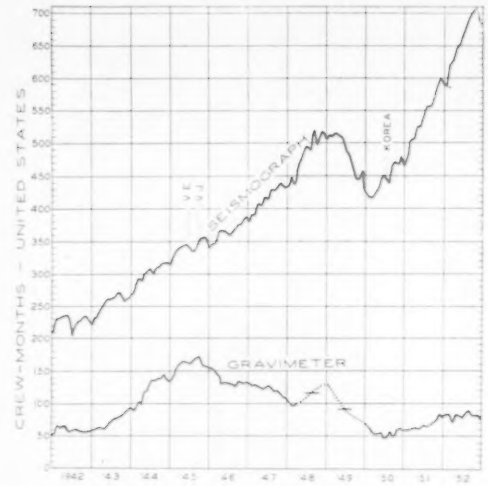

Fig. 1—Monthly variation in seismograph and gravimeter crew-months in the United States.

Fig. 2—Distribution of 1952 seismograph operations in United States.

Geophysical Activity Soars to New

"It is clear that whatever the economic climate may be in the next year or two, increased exploration will be necessary because of the inevitably increasing demand for petroleum products. . . The big problem faced by the operators is manpower."

GEOPHYSICAL activity during 1952 reached a new all-time high. On the basis of incomplete reports, the full-time services of 905 crews were utilized the world over last year, an increase of 114 crews over 1951. The 9,801 crew-months of seismograph work in the United States and Canada alone exceeded the 9,549 crew-month world total of such work in 1951. The figures at hand indicate a slight decrease in gravity operations, but it is believed that when data now missing are received a slight increase will be shown. The reports received on magnetometer activity seem to be neither complete nor reliable, and no attempt seems justified to estimate a trend.

Exploration results appear to have fallen well below the preliminary estimates. The total liquid hydrocarbon reserves proved during 1952 were estimated by the A.P.I. and A.G.A. to be about 3,306 million barrels. Deducting the 1952 production of 2,542 million barrels, the net addition to reserves was only 764 million barrels, which was lower than it was for any year since 1947.

Although United States reserves at the beginning of this year stood at an all-time high of 32.96 billion barrels of liquid hydrocarbons, it is to be noted that this represents only 12.9 years of supply at last year's rate of production. In 1929, United States production first exceeded 1 billion barrels, and in 1952 it was, for the first time, greater than 2.5 billion barrels. In this interval reserves fluctuated between a minimum of 11.9 years of supply at current annual rates of production to a maximum of 15.7 years. The average over this period was 13.4 years. The magnitude of our present reserves, though of record proportions, is not so when expressed in terms of years of supply at current production rates, being below the average for the last 23 years. In fact, the ratio of total reserves to annual production seems to be less for the United States than for any country or area which produces as much as 1 per cent of the world's oil. The supply-demand relationship appears to be currently causing the industry some concern, but in this connection it may be well to remember that in terms of years of supply present reserves are low rather than high.

The month-by-month fluctuation of both seismograph and gravity operations in the United States is shown for the 1942-1952 period in Fig. 1. The most striking feature of this picture is the rapid rise of seismograph activity which began very early in 1950 and culminated in October of last year. This rise carried from a low of 417 crews in 1950 to a high of 710 crews in 1952, representing an increase of about 70 per cent over a period of less than 3 years. By January 1953, the number of crews had dropped to 641, a drop of less than 10 per cent, possibly indicating that we are currently experiencing the kind of adjustment which was encountered in 1949. Related factors are hardly such, at this time, to justify the more pessimistic view that the history of 1937-1941 may be repeated.

The gravity graph in Fig. 1 shows that these operations of last year in the United States fluctuated about the highest level reached the preceding one. The 1952 activity came to a total of

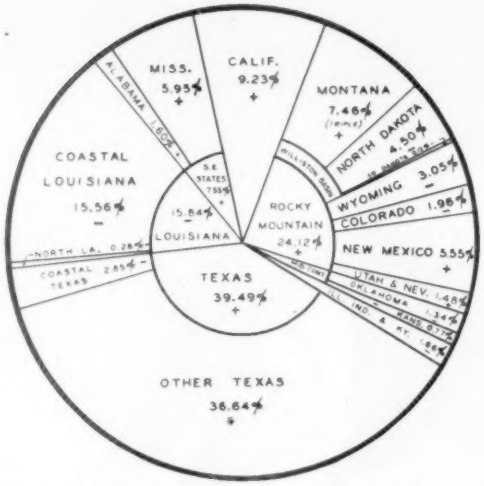

Fig. 3—Distribution of 1952 gravimeter operations in United States.

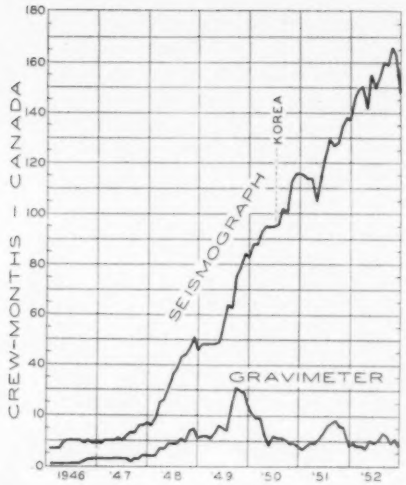

Fig. 4—Monthly variation in seismograph and gravimeter crew-months in Canada.

All-Time Peak in 1952

by E. A. Eckhardt*

965 crew-months against 802 for 1951, an increase of 20 per cent.

The geographic distribution of the 1952 United States seismograph operations is shown in Fig. 2. For the first time since these reports were initiated 6 years ago, Texas and Louisiana together account for less than one-half of the total activity. The concentration of work in the Rocky Mountain states, and more particularly in the Williston basin, is evident in the chart. Table 1 is presented to give additional information concerning the growth and shifts of these activities. The table shows that the increased volume of 1952 was largely concentrated in the Williston basin and adjacent areas, and that this concentration resulted in decreased activity only in Colorado.

The areal distribution of 1952 United States gravimeter operations is shown by Fig. 3. As in all previous reports of this series, the two states of Texas and Louisiana accounted for more than half of the year's work. The distributional changes from the preceding year were pronounced and are indicated in Table 2. There were increases in six and decreases in four of the states listed. The increases were greatest percentagewise in Montana and Mississippi, and the decreases largest in Oklahoma and Colorado. There was an over-all increase of about 20 per cent.

Next to the United States, geophysical activity was greatest in Canada. Seismograph operations increased by 24.6 per cent from 1,479 crew-months in 1951 to 1,843 crew-months in 1952. Gravity operations showed a reverse trend, declining from 147 crew-months to 114, a decline of 22.4 per cent. Enough data are now available to present the course of geophysical activity in Canada over a period of 7 years, and this is done in Fig. 4.

For all of North America, 10,049 crew-months of seismograph work and 1,127 crew-months of gravity work were reported for 1952. The corresponding figures for 1951 were 8,248 and 1,493, respectively. Next to the United States and Canada, Mexico was the principal contributor to these totals. There was, however, little change in the level of operations in Mexico from 1951 to 1952.

In South America seismograph operations increased from 349 crew-months to 459, the increase occurring principally in Argentina, Venezuela, and Colombia. Gravity operations increased from 114 to 158 crew-month, and the increases were accounted for largely by Peru and Venezuela.

Up to the closing time of this report, the data received for the Eastern Hemisphere were not sufficiently complete to justify the presentation of charts or tables. In 1951 Germany and Italy accounted for nearly half the geophysical work done in the Eastern Hemisphere. Though no precise data are available, reliable estimates indicate that the 1952 volume of work in these two countries was greater than the year before. It is impossible to say by how much. The total for the East-

*Gulf Research & Development Co., Pittsburgh. Report of the Committee on Geophysical Activity of the Society of Exploration Geophysicists. The members of this committee are A. A. Brant, Herbert Hoover, Jr., R. Vajk, and E. A. Eckhardt, chairman. Report presented at the Houston meeting of the society, March 23, 1953.

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* Roaming the Cretaceous Period of the Mesozoic Era was the Triceratops, last of the dinosaur group. Man had not yet appeared, but warm-blooded mammals, deciduous trees and other land plants made their first appearance. The Cretaceous Period was characterized by shifting seas and diversified climatic changes.

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ern Hemisphere was also probably as great as or greater than last year.

For the geophysical work done in 1952 for its account, the oil industry probably spent between $350,000,000 and $400,000,000. The increase over 1951 was largely due to increased volume, but partly also to increased unit costs.

It is clear that whatever the economic climate may be in the next year or two, increased exploration will be necessary because of the inevitably increasing demand for petroleum products. Over the years geophysical activity is bound to rise. The big problem faced by the operators is manpower. For the most part, geophysical organizations are concentrating on getting a larger portion of college graduating classes. There is a growing realization that more than this will be required.

The development of our natural resources is basic to the well being of our economy. Yet the percentage of high-school students who receive any kind of training in the earth sciences has been decreasing continuously and markedly in the last 50 years. It was nearly 30 per cent in 1900. It is a fraction of 1 per cent today. Since the interests of young men are directed to a considerable extent before they arrive at college, this tends to minimize the college enrollment in earth-science subjects.

Dr. H. Cloos has dealt with this subject in a recent issue of the News Letter of the American Geological Institute.

TABLE 1—SEISMOGRAPH CREWS MONTHS IN THE UNITED STATES

State—	1951	1952	Per cent change
Texas	2,574	2,670	3.7
Louisiana	1,041	1,083	4.0
Mississippi	148	203	37.2
Oklahoma	371	411	10.8
New Mexico	496	657	32.5
Colorado	297	252	—15.1
Wyoming	317	519	63.7
Montana	255	574	125.1
North Dakota	122	436	257.4
California	208	283	36.1
Other	708	870	21.5
Total	6,537	7,958	21.7

TABLE 2—GRAVITY CREW MONTHS IN THE UNITED STATES

State—	1951	1952	Per cent change
Texas	294	381	30
Louisiana	192	153	—20
Mississippi	15	57	280
Oklahoma	28	13	—54
New Mexico	36	54	50
Colorado	35	19	—46
Wyoming	43	30	—30
Montana	17	72	320
North Dakota	39	43	10
California	43	89	107
Other	60	54	—10
Total	802	965	20

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TABLE 1—EOCENE OIL-PRODUCING FIELDS OF SAN JOAQUIN VALLEY

Field or pool; map No.:	Discovery date	Sand; member	Approx. net avg. thickness (ft.)	Average well depth (ft.)	No. prod. wells 1-1-53	Estimated Jan. prod. bbl. dly.	1952 prod., 1,000 bbl.	Cum. prod. 1-1-53, 1,000 bbl.	Approx. prod. acreage	Avg. gr. crude, °A.P.I.
Alferitz Anticline* (13)	July 1950	Point of Rocks (U)	100	2,100	27	560	130	267	300	18
Antelope Hills (14)	June 1944	Point of Rocks (U)	70	2,300	5	95	44	111	30	18
Belgian Anticline (17)	May 1947	Point of Rocks (U)	†800	5,300	25	5,500	708	1,333	300	37
Ciervo Anticline‡	July 1948	Martinez (L)	60	1,200	3	20	8	19	30	21
Coalinga, Northeast (7)	Apr. 1939	Gatchell (M)	130	8,200	35	1,460	662	33,930	1,500	27
Coalinga Nose (8)	June 1938	Gatchell (M)	360	7,800	113	45,950	16,777	200,731	3,500	30
Cymric (16)	Mar. 1946	Point of Rocks (U)	300	5,500	7	90	34	569	100	45
Helm-Lanare (4)	Feb. 1942	Kreyenhagen gr. (U)	30	8,100	53	1,150	420	7,570	3,500	30
Kettleman, Mid. Dome (11)	Feb. 1947	Domingine (M)	100	11,600	2	95	37	265	80	38
Kettleman, No. Dome (10)	July 1937	Domingine (M)	200	10,700	29	1,950	694	13,320	4,500	48
Pleasant Valley (9)	Feb. 1943	Gatchell (M)	200	9,100	18	1,700	719	10,355	600	29
Pyramid Hills* (12)	July 1940	Point of Rocks (U)	130	1,100	25	160	59	777	150	17
Raisin City (1)	Aug. 1943	Kreyenhagen gr. (U)	15	6,300	11	850	273	2,702	650	29
Riverdale (5)	June 1943	Kreyenhagen gr. (U)	10	7,900	16	500	166	4,157	1,500	36
San Joaquin (2)	Mar. 1947	Kreyenhagen gr. (U)	15	7,000	7	100	40	462	100	30
Turk Anticline (3)	July 1940	Cantua (L)	†115	9,900	2	100	8	12	40	58
Wasco (15)	Sept. 1949	Famosa (U)	†280	15,500	1	100	34	169	40	42
Wheeler Ridge (18)	Apr. 1952	Tejon (?) (U)	300	10,100	4	1,050	144	144	200	35
Total					383	61,430	20,957	276,893		

*Production from Eocene commingled with Miocene crude; all figures given are for both zones. †Estimated total thickness. ‡Not shown on map; lies about 20 miles northwest of Coalinga fields.

PROGRESS REPORT ON

EOCENE SEARCH

. . . in Southern Joaquin Valley

Wildcatting for these deep sands is now hitting its stride after a year of geologic studies following initial discovery at Wheeler Ridge. Two tests may go to 20,000 ft. or deeper.

by D. H. Stormont
West Coast District Editor

OIL production from Eocene formations has been under way in California's San Joaquin Valley for the past 15 years. It was not until last April, however, that oil from these stratigraphically deep sands was found in the southern end of the valley.

Prior to April last year farthest south Eocene production was at Belgian anticline, near McKittrick on the west side of the valley. Discovery of a 10,000-ft. pool by Richfield Oil Corp. at Wheeler Ridge, about 40 miles southeast, thus opened an entirely new province.

Less than a half-dozen wildcats had been carried to the Eocene in this area prior to the Wheeler Ridge discovery. Since then only two extension attempts to Wheeler Ridge have reached the Eocene, aside from four field wells.

After almost a year of leasing and making geological and geophysical studies, however, the tempo of drilling is moving into full stride. In early March approximately 12 such exploratory tests were under way in central and southern portions of the valley. All probably will drill deeper than 8,000 ft. and two possibly may go to 20,000 ft. or deeper.

Development Background

Before further discussing the current search, and areas considered most favorable, a brief discussion of the extent and relative importance of the Eocene in San Joaquin Valley is in order.

Performance of Eocene fields. . . . First Eocene discovery in the valley of commercial importance was at Kettleman North Dome, in July 1937. In the two succeeding years Northeast Coalinga and Coalinga Nose were added. Since then the number of such fields and pools has been raised to 18. As is shown on the accompanying map (Fig. 1), they are principally concentrated in the north valley with a sprinkling along the western edge.

Data on the individual fields and pools are given in Table 1, which is keyed to Fig. 1 for reference. As shown, Eocene rocks have yielded one

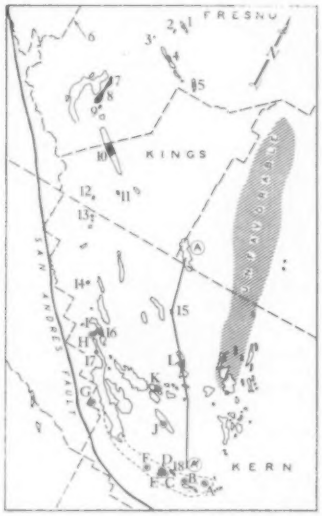

Fig. 1—Portion of San Joaquin Valley showing the fields and pools where Eocene formations produce (numbered), and wildcats under way in search of these stratigraphically deep pays (lettered).

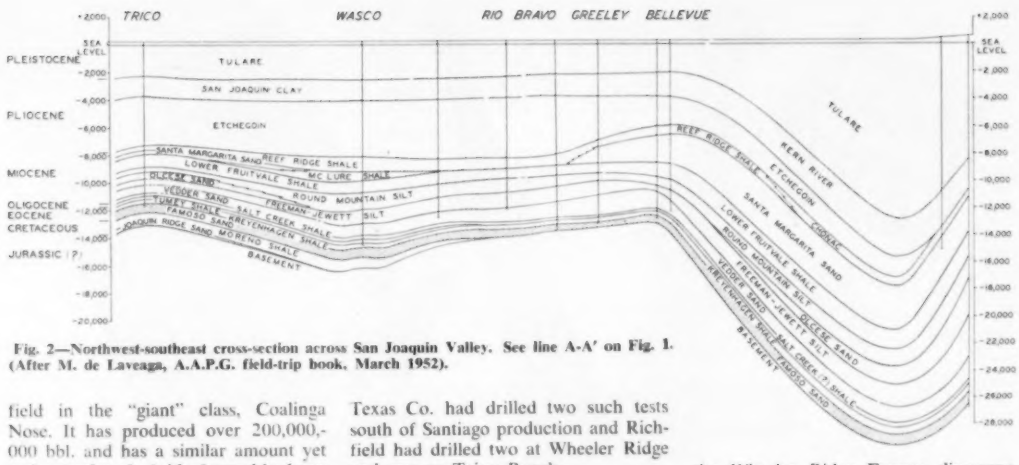

Fig. 2—Northwest-southeast cross-section across San Joaquin Valley. See line A-A′ on Fig. 1. (After M. de Laveaga, A.A.P.G. field-trip book, March 1952).

field in the "giant" class, Coalinga Nose. It has produced over 200,000,000 bbl. and has a similar amount yet to be produced. Aside from this, however, none approaches a 100,000,000-bbl. classification.

Further summarizing, it is seen that Eocene formations accounted for about 60,000 bbl. of the region's 412,000-bbl. January daily production, and their cumulative production on January 1 amounted to 152,000,000 of the 4,071,000,000-bbl. regional total. Two of the pools, Kettleman North Dome and Turk anticline, are condensate reservoirs.

Aside from Wheeler Ridge and a few minor exceptions, all are considered fully developed. Their oil reserves are estimated at about 250,000,000 bbl., or about 11 per cent of the San Joaquin Valley total. The great bulk of this reserve is in sands lying below 7,500 ft.

Earlier South Valley search . . . Prior to the Wheeler Ridge discovery, so far as the author could determine, only five tests had been drilled to the Eocene in the 25-mile stretch from Tejon Ranch west to Maricopa. The Texas Co. had drilled two such tests south of Santiago production and Richfield had drilled two at Wheeler Ridge and one on Tejon Ranch.

East of Tejon Ranch, in the Tejon Hills area, numerous tests had been drilled stratigraphically deeper. They were located east of where Eocene sediments pinch out against the basement complex in rapidly rising from the deep basin to the northwest (see Fig. 2).

About midway between Tejon Hills and Wheeler Ridge, in 2-10n-19w, Richfield drilled 1 Tejon Ranch to 10,940 ft. in evaluating Eocene possibilities. The sands were found to be wet so that the well was abandoned in 1941.

The two other deep Richfield wildcats were 1 and 2 Kern County Land in 28-11n-20w. Drilled between 1938 and 1940 to approximately 11,000 ft., both encountered oil-stained Eocene sand but were abandoned after flowing salt water. Both suggested proximity to the prolific pool but structural control at depth was insufficient to point the way. Such was not developed until about 12 years later; it led to the staking of 85-29 Kern County Land-D, the Wheeler Ridge Eocene discovery well.

TABLE 2—EXPLORATORY EOCENE WELLS
(Status as of March 6)

	Status	Projected depth (ft.)
Tejon Ranch area:		
A—Union Oil Co. 46-24 Reserve-Kerr, 24-11n-19w	7,021	8,000
B—Standard of California 35 C.C.M.O., 32-11n-19w	Rigging	12,000
San Emigdio foothills:		
C—Humble Oil & Ref. Co. 16 K.C.L.-B, 35-11n-21w	923	11,000
D—Richfield Oil Corp. 1 San Emigdio-B, 36-11n-21w	11,122	11,500
E—Richfield Oil Corp. 1 San Emigdio-D, 11-10n-21w	4,719	11,000
F—Richfield Oil Corp. 1 San Emigdio-E, 7-10n-21w	2,997	11,000
Temblor Range area:		
G—Richfield Oil Corp. 78-31 Goyner-U.S.L., 31-32s-23e	3,418	7,500
H—Standard of California 54 Stafford-Bell, 3-30s-21e	5,881	8,000
I—Superior Oil Co. 1 Cymric Unit, 22-29s-21e	3,600	10,000
Central Valley area:		
J—Ohio Oil Co. 72-4 K.C.L.-A, 4-32s-26e	17,540	+18,000
K—Richfield Oil Corp. 67-29 C.L.A., 29-30s-25e	10,931	+18,000
L—Union Oil Co. 62-34 Kernco, 34-28s-25e	Spudding	14,000

Wheeler Ridge Development . . . No. 85-29 K.C.L.-D was completed about ½ mile southwest of the old Wheeler Ridge field, which produces from upper and middle Miocene sands. Drilled to 9,756 ft., and with 7-in. casing cemented at 9,600 ft., it was completed flowing at the rate of 1,170 bbl. of clean 35.3°-gravity crude daily.

Since then four other producers have been completed in the pool, all drilled on 20-acre well spacing and with initial production rates in excess of 1,000 bbl. daily on 18/64 to 24/64-in. chokes. Two attempts of Standard Oil Co. of California to extend productive limits 1¼ and ½ mile east were failures, both finding the Eocene sand wet.

All wells so far have indicated the structure is an elongated dome with an east-west axial trend. The development to date has been on the east plunge. None have been drilled on the west plunge so that no estimate of extent of the productive acreage can be made. It is highly likely, however, that the pool will be confined to Richfield's holdings.

The productive zone is a massive sand which is fine to coarse and locally pebbly, firm to moderately soft, relatively clean, and with moderate to high permeabilities. Top of the pay is found at a depth of approximately 10,000 ft. From the one well which penetrated the section, the southeast offset to the discovery, it appears there is approximately 300 ft. of sand above water.

The reservoir's high pressure with low water saturation is highly unusual for California fields. Shortly after its completion the bottom-hole pressure of the discovery well was gaged at 5,400

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psi., more than 800 psi. above the theoretical hydrostatic head. No gas cap has been encountered to date. It is thought likely that a good water drive will materialize.

In drilling the discovery well, high pressures encountered at about 6,300 ft. caused Richfield to suspect a shallower Miocene pay. The zone was drilled through without testing, however. When the second well was being drilled a formation test was made at 6,300-6,500 ft. A flow rate of 1,114 bbl. per day of 44°-gravity crude was gaged. Following the test the zone was cemented behind casing and the well drilled to and completed in the Eocene pay.

As yet no wells have been completed in this shallower pay, and it appears these sands will be somewhat spotty. The one well which was spudded with the Miocene as an objective found the sands shaled out, and was completed in the Eocene.

Richfield currently is using three rigs in developing the pool, all close to the discovery well. In addition to the three active locations, all in Section 29, four locations have been staked in Section 28.

Current Activity

The current search is largely confined to the Tejon Ranch area, westward through Wheeler Ridge and along the San Emigdio foothills, and then northwest in the southeast portion of the Temblor Range. This area, that dashed on Fig. 1, is considered by many geologists as being the most favorable for finding new Eocene production. Seven wildcats were under way in this area at the first of the month.

In addition two tests searching for lower Miocene and Eocene production were drilling in North Coles Levee and Paloma fields, and a third was starting in Rio Bravo. Status of these wildcats in early March, as well as those in the foothills and Cymric areas, is given in Table 2.

Eocene possibilities along the eastern side of the valley are not believed promising due to these formations being either missing or shaled out. Numerous wells have been drilled between Bakersfield and Dinuba, 80 miles northwest, without success.

Because of intense thrust faulting and folding the search in the San Emigdio foothills will be difficult. In the eastern portion which has been involved in a strong north-south directed stress, tight overturned and isoclinal folds and numerous fault blocks exist. The faults are all south dipping and have low angles, with displacements ranging up to several thousand feet. Eocene formations outcrop at points along the foothills, as do Oligocene, Miocene, and Pliocene. It is estimated that prior to the faulting and folding, the combined marine and nonmarine section exceeded 20,000 ft.*

Richfield has been the leader in this activity, and has approximately 100,000 acres under lease in the region west of Tejon. Standard, after the two unsuccessful extension attempts at Wheeler Ridge, has an Eocene wildcat drilling in the Tejon Ranch area 4 miles east. On a 5,000-acre block recently obtained from Reserve Oil & Gas Co., Union Oil Co. likewise had an Eocene test under way still further east. At Pleito Creek, about 4 miles southwest of Wheeler Ridge, where it has 10 small 4,200-ft. producers, Humble Oil & Refining Co. recently started a test scheduled to go past 11,000 ft.

The two wells at Paloma and North Coles Levee are of particular interest because of their scheduled depths. The Ohio Oil Co. well at Paloma has reached 17,540 ft., and Richfield's test at Coles Levee was below 10,931 ft. Both may pass the 20,000-ft. mark in search of lower Miocene and Eocene sands.

*T. L. Bear and Andrew Vidos, page 271, A.A.P.G. Field-Trip Guide Book, March 1952.

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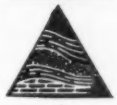

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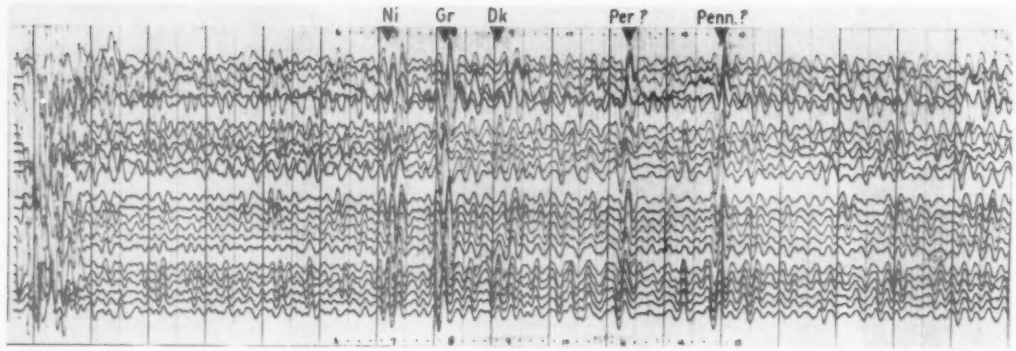
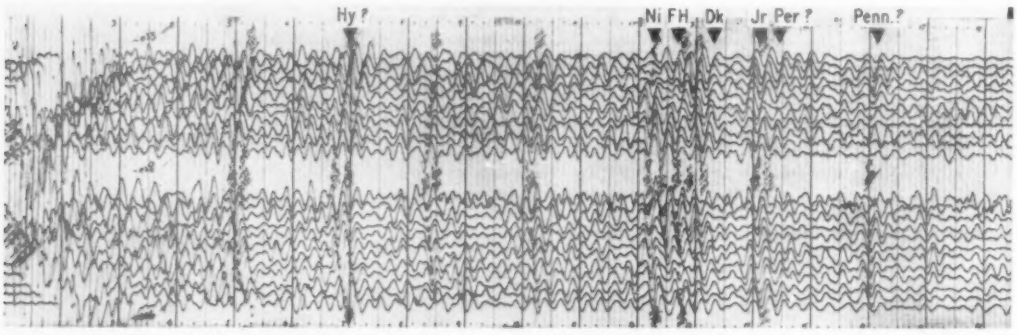


DEUEL COUNTY, NEBRASKA, seismogram was taken from a correlation-shooting survey. Traces in lower half are unmixed while traces in upper half employed mixed electronics.



MORGAN COUNTY, COLORADO, seismogram came from a continuous profiling survey employing mixed electronics. Abbreviations used in both seismograms refer to the following geologic names: Hy—Hygiene; Ni—Niobrara; FH—Fort Hays; Gr—Greenhorn; Dk—Dakota; Jr.—Jurassic; Per—Permian; and Penn—Pennsylvanian.

How geology and geography complicate

SEISMIC PROBLEMS In Denver-Julesburg Basin

Bad lands, sand-dune topography, thick Tertiary cover, and Quaternary mantle complicate shot-hole drilling, equipment mobility, and seismic corrections in this area

by Joseph A. Kornfeld
Mid-Continent District Editor

TABLE 1—PRESENT STATUS OF CONTINUOUS PROFILING EXPLORATION AMONG REPORTING SEISMIC CONTRACTORS IN DENVER-JULESBURG BASIN

Contractor	First year work done in basin	Total crew-months work in 1952	Percentage distribution of seismic activity	
			Continuous profiling	Correlation shooting
A	1933	11½	80	20
B	1936	28	50	50
C	1946	12	50	50
D	1947	12	20	80
E	1951	12	70	30
F	1946	10	50	50

WINTER operational hazards, weathering corrections, velocity gradients, and deep well-survey control pose major problems in seismic operations conducted in the Denver-Julesburg basin. The majority of the present oil and gas fields in the basin have been located and drilled on seismic anomalies. Hence a review of the principal seismic problems encountered in seismic work in that area is timely in view of the mounting reserves and the producing position of the region.

Commercial importance . . . At this writing there are 67 oil and 7 gas fields in the Denver-Julesburg basin. Of this total, 34 oil and 4 gas fields are situated in northeastern Colorado. Thirty oil fields and three gas fields are located in southwestern Nebraska. Three oil fields are productive in the Laramie County, Wyoming, portion of the basin.

Structural Geology

The Denver-Julesburg basin is a broad, asymmetrical structural depression in the Paleozoic and Mesozoic systems; the basin lies immediately east of the Rocky Mountains in east-

. . . Denver-Julesburg's Exploration Problems

GEOLOGICAL FACTORS: Subsurface . . . Low-displacement faulting in and immediately above Graneros-Dakota series (main producing reservoirs) can be resolved only by continuous profiling. Faulting affects local accumulations of oil and gas. Regional tilting has altered original relationship of accumulation to structure. Highly lenticular character of Graneros-Dakota sands complicates character of reflections.

GEOLOGICAL FACTORS: Surface . . . Thick Tertiary cover and Quaternary mantle with sand-dune and bad-land topography in places introduces problems in both shot-hole drilling, equipment mobility, and near-surface corrections. Rejuvenated topography in places involves corrections including complex weathering conditions and rapid variations in surface elevations.

RECORD QUALITY . . . Quality of seismic records generally good throughout the basin; however, there are some poor areas. Reflections of primary quality are associated with the Niobrara series, Greenhorn limestone, and the top of the Graneros-Dakota series.

SEISMIC CORRECTIONS . . . Relative low relief of basin's subsurface structures accentuates critical character of near-surface corrections; amount of closure lies almost within limits of error of seismic method. Variety of topography and surface materials introduce a major problem in selection of proper correction method for a given sector.

INTERPRETATION . . . Problems of seismogram interpretation concern mainly the interval from the top of the Niobrara to the Graneros-Dakota; faulting, sedimentation, and frequency anomalies complicate seismic records in this interval.

FIELD PROBLEMS . . . Drill-hole production lowered where thick Tertiary cover makes necessary drilling of deep holes. Unconsolidated sands and gravels in the Tertiary Ogallala formation often cave into hole, makes hole loading difficult, doubles time to drill, and causes loss of depth in hole for second and subsequent shots. Dune sand reduces mobility and causes broken axles, U-joints, etc., reducing efficiency of drill crews. Detonation difficulties encountered under deep-hole, high-pressure conditions.

WINTER EFFECTS . . . Cold, windy spells cut seismic profile production by as much as 20 per cent. Crew performance improved through winterizing automotive equipment, use of special geophysical equipment, and improving comfort for drill-crew personnel against subzero temperatures.

ern Colorado, southeastern Wyoming, and southwestern Nebraska. A thick Tertiary cover is present over parts of the basin; in places it is mantled with extensive Quaternary deposits which presents a major problem to geophysical exploration.

The basin attains a maximum length of 400 miles from north to south; its maximum width is 250 miles.

The asymmetrical shape of the basin is featured by a steep west flank and surface rocks at high angles dip into the deeper parts of this depression. This is in contrast to the very gentle dips which characterize the eastern slope extending throughout all of northeastern Colorado, and most of the producing oil and gas fields in this basin are found on the eastern limb.

Two areas of maximum downwarp are known from deep-well data and seismic surveys. These are known as the "Denver low" which extends north of the city of Denver, and the "Cheyenne low" which lies adjacent to the city of Cheyenne. Estimated subsea depth to the top of the basement rocks at both of these lows is 7,000 ft. (See map.)

The basin is bounded on the west by the Front Range and Laramie uplifts, on the north by the Hartville and Black Hills uplifts, on the northeast by the Chadron (Cambridge) arch, and on the south by the Apishapa uplift.

Producing Reservoirs

Producing sands are found principally in the "D" and "G" sands in the Graneros-Dakota series of Upper Cretaceous age and in the "J" sand of Lower Cretaceous age. Depth to production ranges from as shallow as 3,500 ft. on the east edge of the basin to more than 8,400 ft. in Borie field near Cheyenne, Laramie County, Wyoming, on the steeply dipping west limb of the basin.

Effect of Regional Tilting

One geophysicist observes that the occurrence of oil and gas accumulations in the Denver-Julesburg basin is not directly related to presently existing closures; he cites many fields which are situated on terraces.

His explanation of the accumulations occurring principally in terraces rather than in anticlines is that tectonic movements occurred subsequent to Cretaceous time during which the critical east dip was altered by regional tilting of the eastern limb of the Denver-Julesburg basin. For example, this would affect substantially the attitude of structures producing in the Sterling area of Logan County, Colorado.

Adams[1] has cited a similar instance to account for the accumulation of oil in an open reservoir in Wheat field of Loving County, Texas, in the Delaware basin. Originally, Wheat field was the site of a pronounced anticline which was altered to a terrace by regional tilting.

If the oil and gas accumulation occurred prior to regional tilting, there would be an adjustment of fluids in the reservoir. Thus, an oil rim which occurred in an anticline would now occupy the basinward side of structural terrace.

Water-Filled Reservoirs

A regional geologic condition analogous to the west side of the East Texas Woodbine basin explains the absence of oil and gas in structural closures on the northeastern flank of the Denver-Julesburg basin (or the southwestern flank of the Chadron or Cambridge arch). Closures in the Graneros-Dakota series of Upper Cretaceous age carry sweet water instead of oil and gas.

One hypothesis developed to account for this phenomenon is that surface water seeped into the surface section, migrated down to the Muddy series and flushed out any oil that may have accumulated in earlier geologic time. It is known that there is an adequate aquifer in northern Garden County, Nebraska, and adjacent areas; this is characterized by sand-dune topography in which depressions are filled with water; this water could seep into the underground reservoirs described above.

Low-Displacement Faulting

Considerable faulting of low order of magnitude, i.e., 40 to 210 ft. in vertical displacement, characterizes the structure of the Cretaceous section on the east limb of the Denver-Julesburg basin, particularly in the Huntsman area of Cheyenne County, Nebraska.[2]

This condition occurs particularly in the interval occupied between the top of the Niobrara chalk and the Graneros-Dakota formations.

Faulting affects the validity of a contour datum map prepared on top of the Niobrara reflections as a structural guide to the attitude of the Graneros-Dakota series; the latter contains most of the producing oil fields of the Denver-Julesburg basin. For this reason most geologists do not rely on the Niobrara as a contour datum.

Ordinarily, a seismic anomaly determined by **correlation means** will not resolve faults of this order of magnitude. However, **continuous profiling** may isolate faults of this order of magnitude; consequently, the initial exploratory test drilled on a correlation seismic anomaly in the Denver-Julesburg basin does not condemn the possibilities for encountering commercial oil or gas production. It is therefore possible that the offset to a dry hole drilled on the downthrown side of a local fault (on a seismic anomaly) could encounter a commercial oil or gas accumulation.

First Seismic Discovery

Prior to 1942, considerable seismic work was conducted in covered portions of the basin without favorable results.

The first seismic discovery in the Denver-Julesburg basin was made during 1943 when Horse Creek field northwest of Cheyenne was completed as a discovery oil well. This successful find proved the resolving power of the seismograph to discern buried subsurface structures beneath the thick Tertiary cover.

The same year, Ohio Oil Co. commenced a broad reflection seismic exploratory program commencing at the Wyoming-Colorado line and extending eastward into Logan and Washington counties in northeastern Colorado.

Ohio Oil stepped up its seismic exploratory program in the spring of 1946 northward into the counties of Deuel, Cheyenne, Garden, and Morrill in southwestern Nebraska. This firm developed a number of important oil and gas fields in Cheyenne and Deuel counties subsequent to 1949. Other seismic work was done to the east throughout Chase, Dundy, and Perkins counties.[3]

Types of Reflection Shooting

When seismic work was started in the Denver-Julesburg basin, most of the early shooting was jump correlation conducted at intervals of about ½ mile. In recent years there has been a strong movement towards continuous profiling which affords the resolving power required to discern the low-displacement faulting prevalent in much of the producing areas of the basin.

Despite the predominance of continuous profiling throughout the basins of the United States, an appreciable amount of correlation shooting still prevails in the Denver-Julesburg as well as the Williston basin. The percentage distribution of five reporting seismic contractors appears in Table 1.

Division of Area

Rummerfield[4] has divided the Denver-Julesburg basin into two areas on the effect of surface geological beds on geophysical exploration as follows:

1. That part of northeastern Colorado in which the Upper Cretaceous beds are exposed (Pierre shale and the Fox Hills sandstone).

2. That portion of southwestern Nebraska in which the surface beds consist of Tertiary (Ogallala and Arikaree) deposits and Quaternary alluvium and wind-blown sands.

However, the so-called "sand hills" and the loess-covered parts of Nebraska do not present the same problems that are seen in the portions of Morrill and Scotts Bluff counties that are covered by a deep Tertiary cover. Ohio Oil Co. geophysicists note that where the dune sand and loess of the Pleistocene are present, holes of 200 ft. or less will suffice, and a "two-drill" seismic crew can average 8 to 10 holes per day by preloading multiple charges in the portions of the basin near the Chadron arch and westward as far as Alliance, Neb.

Portions of the basin where the more difficult drilling conditions have been reported are near the Nebraska-Wyoming border where the Tertiary cover is thick and surface elevations are regionally high. Examples are the vicinity of Bridgeport in Morrill Coun-

TABLE 2—COMPILED VELOCITY MEASURMENT AND CONCLUSIONS FOR SHALE AND SAND SECTIONS

Mean depth Z (ft.)	Depth interval ΔZ (ft.)	Time interval Δt (sec.)	Interval velocity ΔZ/Δt (ft./sec.)	No. of wells	Location of wells*	Mean deviation (ft./sec.)	Maximum deviation (ft./sec.) Minus	Maximum deviation (ft./sec.) Plus	$V = a_m Z^{1/6}$ dZ/dt (ft./sec.)	$V = a(ZT)^{1/6}$ dZ/dt (ft./sec.)
					EOCENE					
1,025	1,950	.277	7,050	11	Mi L Al C T Co W Ar	502	580	1,030	7,350	7,450
2,500	1,000	.126	7,940	12	Mi L Al T Co C Ar	364	790	1,060	8,600	8,630
3,500	1,000	.118	8,510	12	Mi Al L Mo	598	950	2,390	9,100	9,120
4,500	1,000	.109	9,190	7	Mi Al L C	581	790	1,510	9,500	9,530
5,500	1,000	.099	10,070	7	T Mi L C	663	920	1,510	9,800	9,849
6,500	1,000	.099	10,030	3	T Mi	730	1,100	600	10,100	10,120
7,500	1,000	.096	10,310	4	T Mi	567	1,400	950	10,350	10,380
11,000	2,000	.179	11,130	4	T	617	930	850	11,050	11,070
					CRETACEOUS					
1,025	1,950	.256	7,620	10	Mo D T Ar L W A	235	800	430	8,200	8,450
2,500	1,000	.114	8,750	14	D T Ar L N Co W A	431	920	630	9,500	9,820
3,500	1,000	.101	9,860	13	Mi Mo D T Ar L W A Co	464	1,240	840	10,100	10,380
4,500	1,000	.090	11,060	3	Mi T W	50	70	40	10,550	10,810
5,500	1,000	.088	11,320	7	T Mi Ar W	274	440	410	10,950	11,190
6,500	1,000	.085	11,710	4	T Ar L W	1,097	1,980	2,190	11,250	11,510
7,500	1,000	.075	11,800	2	T D	700	700	700	11,500	11,800
8,500	1,000	.083	12,050	3	T Mi Co	465	350	700	11,750	12,050

Source: Faust, L. Y., "Seismic Velocity as a Function of Depth and Geologic Time," Geophysics, Vol. 16, No. 2, pp. 192-206, April 1951.
*Key to location of wells: A—Alberta; Al—Alabama; Ar—Arkansas; C—California; Co—Colorado; D—North Dakota; I—Illinois; K—Kansas; L—Louisiana; M—New Mexico; Mi—Mississippi; Mo—Montana; N—Nebraska; O—Oklahoma; P—Pennsylvania; T—Texas; and W—Wyoming.

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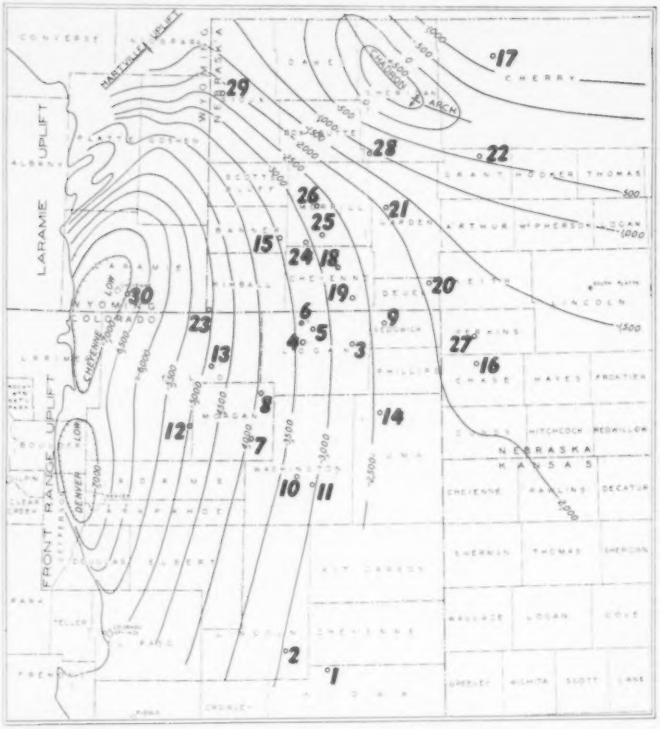

SUBSURFACE STRUCTURE contour map of Denver-Julesburg basin mapped on top of the basement complex using mean sea-level datum. Numbers refer to wells shot for velocity which are described in Table 3.

ty, Gering in Scotts Bluff County, and Harrisburg in Banner County.

Areas contrasted . . . In Area 1, the drilling of seismic shot holes is a relatively simple procedure; good records may be expected by shooting at relatively shallow depths.

The presence of thick beds of sand and gravel in Area 2 (the regions covered by Tertiary and Quaternary beds) causes considerable difficulty in the drilling of shot holes. Because of this condition, it is necessary to drill relatively deep in some cases.

Shot-Hole Drilling

Generally, rigs capable of drilling 1,000 ft. are employed for shot-hole work in the Denver-Julesburg basin.

Several criteria are employed in determination of the depth to which a shot-hole is drilled in this region. The predominant factor is the geologic character of the near-surface rocks.

Tertiary-Quaternary cover . . . Shot holes drilled beneath Tertiary and Quaternary cover require drill depths ranging from 200 to 600 ft. In Kimball County, Nebraska, the Tertiary is about 1,000 ft. in thickness; therefore, the drilling of shot holes to this depth is neither practical nor economic.

Where thick cover of Tertiary sediments occurs, shot holes are drilled by some contractors to a depth of 30 ft. below the water table. In other areas,

TABLE 3—WELLS SHOT FOR VELOCITY IN THE DENVER-JULESBURG BASIN*

Map initial	County—Company, lease and description—	Depth surveyed	Shot by	Date	Sponsored by
	COLORADO				
1	Kiowa—Gulf Oil Corp. 1 Risser, C SW NE 1-17s-50w	6,145	SSC	1937	OKWSA
2	Lincoln—Gulf Oil Corp. 1 Smith, C SW SE 19-15s-53w	6,100	Gulf	1937	OKWSA
3	Logan—Deep Rock Oil Corp. 1 State, SW SE NW 1-9n-49w	4,535	SSC	1951	Sunray Oil Corp.
4	Logan—Amerada Petroleum Corp. 1 Mittelstadt, NW SE SW 14-9n-52w	5,153	Amerada	1951	Amerada Pet. Corp.
5	Logan—Carey-Plains-Republic 1 Conklin, C NW SW 23-10n-51w	4,443	SSC	1950	Exploration
6	Logan—Plains Exploration Co. 1 Gillham, C NW SE 23-11n-52w	4,902	SSC	1949	RMSWSA
7	Morgan—Murphy & Carey 1 Mowery, C S½ NW SE 6-2n-56w	5,994	Shell	1949	RMSWSA
8	Morgan—Skelly Oil Co. 1 Scott-Wollever, NE NE SE 30-6n-55w	5,985	SSC	1951	Skelly Oil Co.
9	Sedgwick—Stanolind Oil & Gas Co. 1 Price, C NW SW 35-11n-47w	3,882	SSC	1952	RMSWSA
10	Washington—Amerada-Sinclair 1 Heyen, NE NW SE 7-2s-52w	7,610	Amerada	1952	Amerada Pet. Corp.
11	Washington—Chicago Corp. 1 Sheets, SE SE SW 11-3s-51w	7,396	Rayflex	1952	Chicago Corp.
12	Weld—Tide Water Associated 7-1 Weld Co., NW SW SW 1-3n-61w	6,980	IXC	1945?	RMSWSA
13	Weld—Shell Oil Co. 1 Hanson, NE NE NE 33-8n-59w	7,242	Shell	1950	Shell Oil Co.
14	Yuma—Ohio Oil Co. 1 Braphy, SE SE SW 31-4n-46w	6,370	GGC (?)	1951	Ohio Oil Co.
	NEBRASKA				
15	Banner—British-American Oil 1 Crantz, SW SW NW 28-18n-53w	6,050	SSC	1951	RMSWSA
16	Chase—Skelly Oil Co. 1 Kilpatrick, NW NW SW 15-8n-39w	5,303	SSC	1951	Skelly Oil Co.
17	Cherry—Champlin Refining Co. 1 Shadbolt, NW NW NW 1-31n-37w	3,370	PCI	1952	British-American
18	Cheyenne—Ohio Oil Co. 1 Knievel, NE SE SE 2-15n-49w	5,019	GGC	1950	Ohio Oil Co.
19	Cheyenne—Frank & Schoen 1 Henzl, SE SE SE 25-13n-48w	4,662	Shell	1951	Shell Oil Co.
20	Devel—Magnolia Petroleum 1 Robb, SE SE NE 18-14n-42w	5,825	Magnolia	1952	Magnolia Pet. Co.
21	Garden—Stanolind Oil & Gas 1 Eldred, NE NE NW 32-20n-45w	3,825	Stanolind	1950	RMSWSA
22	Grant—Magnolia Petroleum 1 Abbott, NE NE NW 22-24n-38w	4,000	SSC	1936	Carter Oil Co.
23	Kimball—Gulf Oil Corp. 1 Miller, C SW SW 7-12n-58w	7,999		1951	RMSWSA
24	Morrill—British-American 1 Worth, NW NW NW 9-17n-51w	5,505	SSC	1950	British-American
25	Morrill—Fisher-Stout 1 Marrin, SW SW NW 35-18n-50w	5,002	PGC	1952	Chicago Corp.
26	Morrill—Simmons-Bonney 1 Byer, SW SW SW 18-20n-50w	4,132	PGC	1952	Chicago Corp.
27	Perkins—Ohio Oil Co. 1 State, NW NW SW 16-10n-39w	5,324	GGC	1950	Ohio Oil Co. (?)
28	Sheridan—Los Nietos 1 Bauer, C NW SE 4-25n-46w	3,157	SSC	1951	RMSWSA
29	Sioux—Continental Oil Co. 1 Wear, NW NW NW 10-29n-57w	6,145	SSC	1951	RMSWSA
	WYOMING				
30	Laramie—Amerada Petroleum Corp. 1 Morton, C SW SW 13-13n-66w	6,700	GRC	1936	GRC

*Includes data furnished by Society of Exploration Geophysicists, Colin C. Campbell, secretary, Tulsa. RMSWSA—Rocky Mountain Seismic Well Shooting Association. OKWSA—Oklahoma-Kansas Well Shooting Association.

holes are dug to a common subsurface datum.

In one particular area, where it was possible to drill through the Tertiary beds, a consistent red clay bed was encountered immediately above a blue shale in the Pierre formation of Upper Cretaceous age. The red marker bed was persistent and field experience proved that the blue shale top was a stratigraphic surface and not an erosional surface; the structural attitude of the shallow red marker bed conformed with the folding in the reflecting horizons at depth. Another contractor drilled shot holes 50 ft. into the blue clay of the Pierre shale where conditions permitted doing so.

Tertiary-Cretaceous contact . . . Where there is pronounced relief on the Tertiary-Cretaceous contact, conditions occur that may lead to erroneous conclusions unless recognized properly. In this case, differences in velocity result in local error of appreciable magnitude.

Cretaceous outcrop . . . In areas where the Cretaceous is exposed at the surface, shot holes are drilled to depths ranging from 60 to 100 ft.

Depth of low-velocity materials are calculated as long as velocities continue to increase in succeeding formations. However, if reversals in velocities are found in the near-surface materials, the shot hole must be dug through the low-velocity material.

The only way to determine the depth to the base of the low-velocity material is to drill a deep shot hole. In so doing, a velocity profile is conducted in the shot hole; charges are detonated every 20 to 40 ft. in the hole and marked changes observed in velocities.

Low-velocity "sandwiches" . . . Occurrence of low-velocity beds in shallow formations "sandwiched" between high-velocity beds (determinable only by drilling) presents a real problem. Velocity is a function of lithology geologic time, and depth among other factors. Velocities observed from a compacted clay outwash will be higher than those observed from an unconsolidated sandstone.

A reconnaissance type of correlation seismic control is obtainable in the Denver-Julesburg basin since record quality is sufficiently good. In these cases, shot holes are placed either at section corners, or on half-section lines, at intervals of about 1 mile. In a few cases shot holes are located near the center of sections.

Since the objective is to obtain maximum coverage in a minimum of time, this control is maintained sufficiently flexible to allow considerable latitude in the location of shot points.

Geophone spread . . . Design of the spread of geophones arrangement should be to obtain maximum record quality. Use of short geophone intervals and shot-point cluster of geophones proves advantageous in obtaining high-quality records to be used in correlation interpretation. Placing of a group of geophones equidistant around the shot point allows a comparison between the near geophones which are used to obtain the reflection times. In this way, any trace that appears erratic can be ignored in the timing of the reflections.

"Split spreads" or "end on" spreads are satisfactory for the continuous profiling program. Preference is given to split spreads because of the smaller number of shots necessary from each shot hole.

Record Quality

Quality of seismic records is generally good over most of the Denver-Julesburg basin; however, poor records have been experienced in some areas. Reflections of primary quality are associated with the Niobrara series, Greenhorn limestone, and the top of the Dakota.

Reflections which are transient and therefore not reliable for mapping purposes, except in local areas, include: (1) reflections in the Hygiene sand series of the Pierre shale; (2) reflections intermediate from the Niobrara and the Graneros-Dakota; and (3) reflections occurring below the Graneros-Dakota.

Interpretation Problems

Problems arising from interpretation of seismograms occur in connection with mapping of the "D" reflection (or that associated generally with the top of the Dakota sandstone). As cited elsewhere in this article, the Niobrara is not a reliable contour datum.

There is technical proof to the occurrence of an interplay among several possible geophysical factors which give rise to trouble in interpretation as the result of subtle differences of velocity in the interval between the top of the Niobrara and the top of the Dakota.

This conclusion was suggested by instances where the Niobrara-Dakota iso-time (or iso-chron) was at variance with the interval between the Niobrara and the "D" sand as observed in oil-well bore holes.

Explanation cited . . . Possible explanations cited for this phenomenon by Smith[5] include:

1. **Faulting** — distortion caused by faulting in the Niobrara which does not persist to include faulting in the Dakota series.
2. **Sedimentation** — lithologic differences and differences in formation thicknesses between the members lying between the Niobrara and the Dakota.
3. **Sedimentation**—differences in the Dakota reflector itself; this is demonstrated by the virtual absence of the "D" sand in some wells as compared to its prominent presence in other wells. Differences in cementation of the Dakota sands occur as shown by the variation in the porosity and permeability as found in the many wells drilled.
4. **Frequency** — differences in frequency of the reflected response comprise a factor and this cause is partly attributable to other reasons cited above.

Range of Velocities

Paterson[6] describes that it is not uncommon in the Rocky Mountain region to find the interval velocity increasing from 10,000 ft. per second in consolidated rocks immediately below the weathered zone to 18,000-20,000 ft. per second in those sediments overlying the basement complex.

The Rocky Mountain region is well known for its diversified topography and geology; each intermontane basin presents separate and distinct terrain. Geologic rocks ranging from Recent to pre-Cambrian in age can be encountered over a surface traverse of only a few miles.

High topographic relief is associated with areas of complex structure, almost without exception. Therefore, because of these widely differing geologic conditions existent throughout this region, the velocity in rocks immediately underlying the weathering zone may be from 5,000 ft. per second to as high as 13,000 ft. per second.

Eocene velocities . . . In a recently published compilation, Faust[7] cites Eocene interval velocities from geophysical surveys conducted in Colorado, ranging from 7,050 to 7,940 ft. per second.

Cretaceous shale interval velocities within the Colorado portion of the Denver-Julesburg basin range normally from 7,620 to more than 10,000 ft. per second; sand stringers will exhibit velocities up to more than 13,000 ft. per second. A list containing the velocities appears in Table 2.

Regional Velocity Gradient

An increment of velocity amounting to about 40 ft. per second per mile of dip basinward in the Denver-

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Julesburg province is reported by Smith.[9] He observes that this increment is related closely to the regional dip of about 45 ft. per mile as contoured on top of the Dakota series.

Velocity-gradient calculations, of course, are dependent upon the reference plane (near the surface) from which they are computed. However, this is not a factor on small seismic prospects.

Seismic Corrections

The relatively low relief of many of the subsurface structures of the Denver-Julesburg basin accentuates the critical character of the near-surface corrections. Rummerfield[9] points out that the amount of closure of some of the anomalies lies almost within the limits of error of the seismic method.

The problem of seismic corrections is a major one in this area under discussion. Here are found a wide variety of both surface materials and topography. Thralls and Mossman[10] point out that the arbitrary application of any set type of near-surface corrections to seismic data can lead to erroneous results. They note that the total number of correction variables is approximately the same as the possible combinations of geologic materials and variations in overburden. The interpreter must be willing to change his calculation procedure and velocity assumptions for each change of physical condition in the weathered zone in order to obtain valid results.

Young topography . . . In a case involving young topography, a resolution was obtained by using a "floating" reference datum drawn arbitrarily at the approximate mean of the horizontal datum and the base-of-shot datum. This method resulted in reasonably accurate well ties.

Rejuvenated topography . . . Parts of the Denver-Julesburg basin may be representative of rejuvenated topography. Thus, where a mature topography has been rejuvenated by uplift, a combination of correction problems may be encountered involving both complex weathering conditions and rapid elevation variations. This might be one of the results of postulated regional tilting.

The latest available list of wells in the Denver-Julesburg basin which have been shot for velocity determination appears in Table 3. The respective position of each well in the basin is shown on map.

The list of wells drilled in Colorado includes exploratory tests in Kiowa, Lincoln, Logan, Morgan, and Weld counties.

Additional well-velocity surveys are needed in areas of thick Quaternary mantle to supplement available information on near-surface velocities.

Where there is a thick cover of Tertiary sediments, deep drill holes are required. This cuts down drill-hole production.

Presence of unconsolidated sands and gravels in the Ogallala formation causes frequent caving into the hole; this makes hole loading difficult and causes loss of depth in hole for the second and subsequent shots.

Dune sand covers much of the area along the South Platte River in the southwestern Nebraska portion of the basin, posing mobility problems and causing lost time because of broken axles and U-joints.

Although a seasonal problem, long water hauls are necessary in some areas. The problem of providing water for drilling in areas of porous surface sands was solved by excavating earthen tanks, bottom sealing with bentonite, drilling water wells, and installing water pumps.

Detonation difficulties were encountered with the usual high-velocity seismograph dynamite under high pressures logged in deep shot holes.

Winter Effects on Seismic Work

Thomsen and Burton[11] observe that efficient, year-round operations can be maintained in the Rocky Mountain region. They cite experiences of a number of crews which have worked at least 12 consecutive months in northeastern Colorado, as well as Montana and Wyoming. These records include those examples where considerable attention has been given to flexibility in geographical selection of shooting areas, and where there has been proper winterizing of field equipment.

However, one seismic contractor reports that winter reduces seismic production by as much as 20 per cent. Another contractor stated that winter causes slowdowns particularly where high wind prevails; he noted that drifted snow affected mobility in some areas. A third contractor wrote that work interruptions due to winter weather were limited to only a few days and this was due mainly to drifted snow.

In northeastern Colorado, seismic production (as measured in number of profiles surveyed per crew per month) is high during the months of February, March, and April. Lowest production took place during December and January. Performance records prove that the months of peak activity in the Rocky Mountain region (May through November) do not coincide with the months of maximum production of seismic profiles.

Principal problems governing maximum efficiency of a geophysical field party during the winter season relate to: (1) general automotive equipment, (2) special geophysical equipment, and (3) personnel.

Automotive equipment . . . Generally, most automotive equipment employed by seismic crews operate satisfactorily during the winter season of seismic operations. If equipment is to be left in the field overnight, considerable winterizing must be done to avoid operational trouble. Automotive winterizing precautions include: cab weatherproofing, installation of reliable heaters, elimination of conditions which would lead to ice or frost formation, and use of proper winter-grade lubricants. In addition, batteries must be maintained at full charge to insure quick starting.

Special geophysical equipment . . . Formation of ice in mud pumps poses the principal problem arising from maintenance of efficient shot-hole drilling operations. Despite installation of drain plugs, sufficient moisture will be left to allow freezing of valves to the seats. Circulation of the motor exhaust through jackets or coils around the pump or direct exhaust circulation through the pump, kelly, foot valves, and flow lines, have solved this problem.

Discharge lines on water trucks and vacuum loaders must be winterized as well; in these cases, circulation of motor exhaust around these parts solved the problem of adequate winterizing.

Installation of a heater inside of the water tanks proved helpful in preventing ice formation on tank walls and baffles.

A portable mud sump with properly designed baffle systems comprises a highly valuable adjunct to shot-hole drilling equipment. This equipment item cuts down the amount of time required to drill a shot hole considerably in that it eliminates the need to dig a sump where there is frozen ground.

Use of hot-air blowers during winter operations keeps the rotary table, tongs, slips, and control levers free from ice. Through improvement of safety conditions and drilling-crew comfort, its use lowers substantially the amount of time required to drill shot holes.

Seismic recording equipment is affected only to a mild extent under conditions of subfreezing temperatures. However, condensation of moisture and frost formation cause trouble to optical systems and amplifier chassis.

In camera motors, paper-speed variations, resulting from congealing of

lubricants, have been eliminated by the placing of heating elements in camera housings.

Standard seismic explosives supplied for Rocky Mountain area operations contain sufficient antifreeze compounds to lower freezing points below lowest anticipated field temperature.

Personnel . . . With proper clothing and equipment, effective field work can be conducted under temperatures prevailing to a low as 15° to 20° below zero, if there is no wind. Portable field heaters and wind screens provide protection and warmth, particularly applicable to drill-crew personnel.

Where work is conducted in sparsely populated regions, at least two men should be kept together at all times. Radio communication between field and base of operations forms a highly desirable phase of operations to take care of breakdowns, blizzards, or other emergency conditions as well as to increase efficiency of work during normal operations.

Acknowledgments

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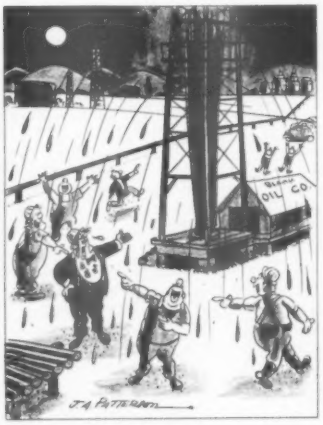

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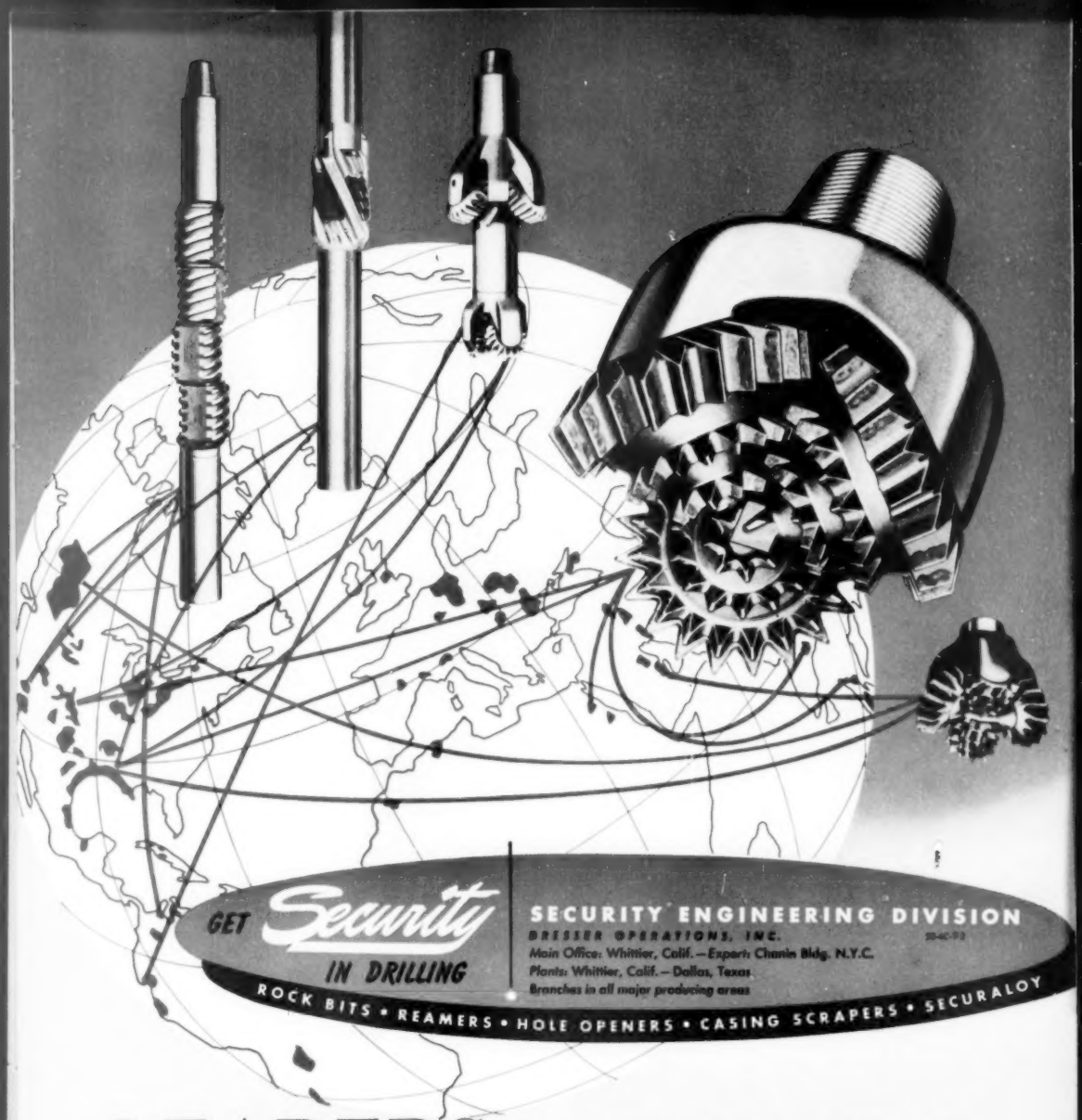
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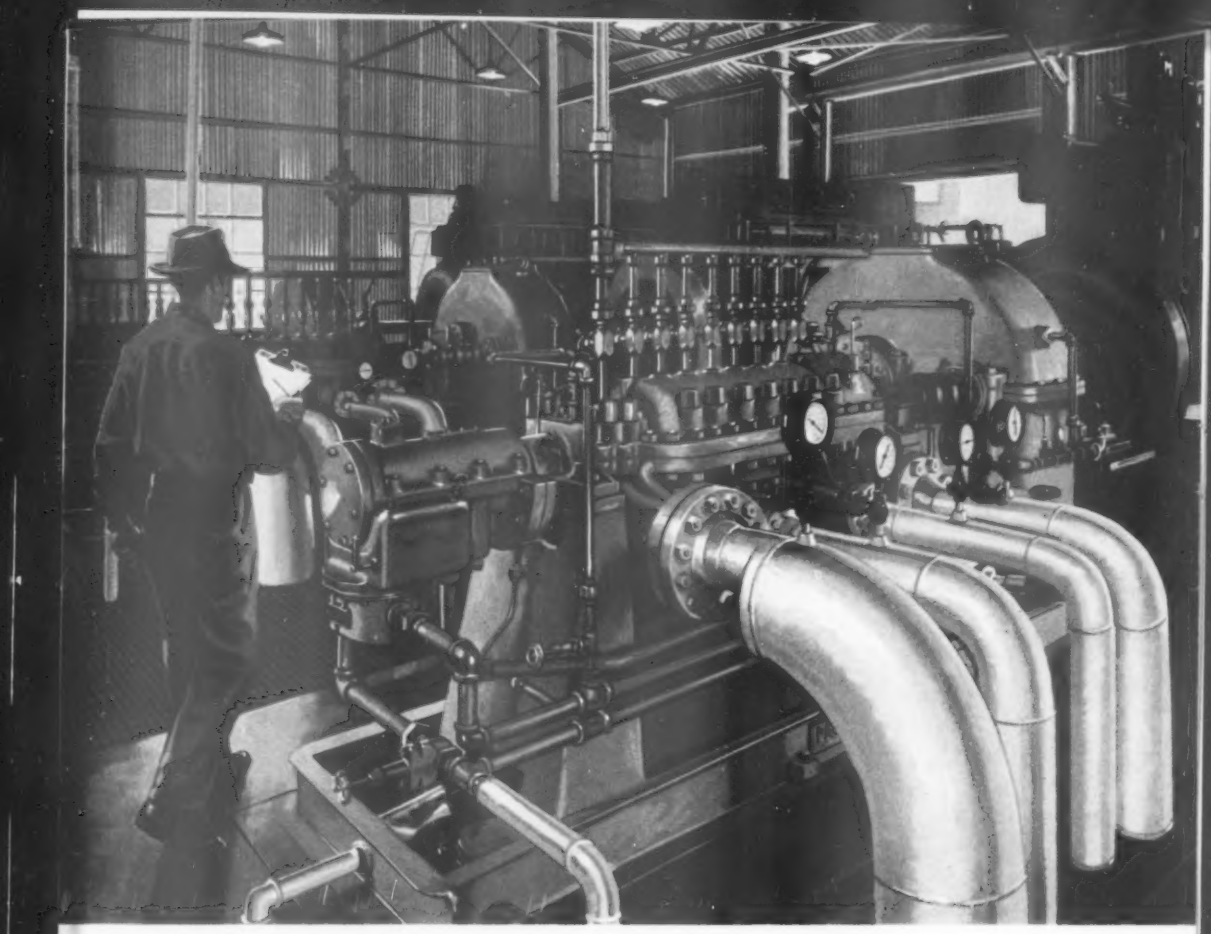

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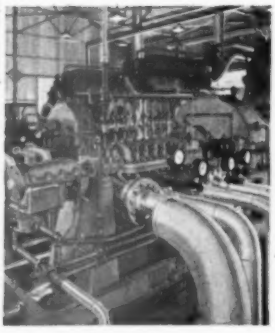

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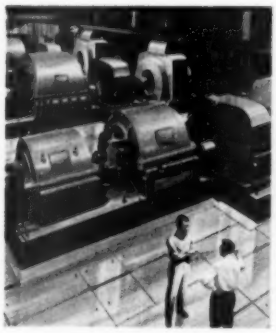

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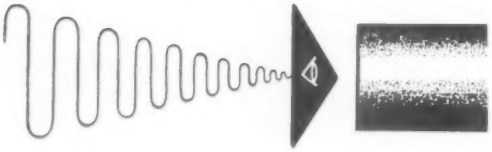

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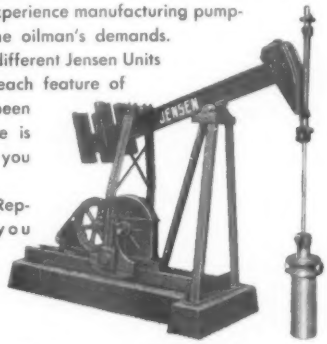

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The Petroleum Geologist . . .

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by Morgan J. Davis*

THE petroleum geologist has contributed to the science of geology (1) by exploring vast areas of the earth and thereby adding to our knowledge of stratigraphy, structure, and sedimentation; (2) by devising or stimulating the development of procedures and ideas to find answers to the problems encountered in his exploration—problems in which correct answers often require a revision of long-standing conceptions; (3) by wider application of the techniques and interpretations of related sciences.

Probably one of the most significant contributions to the philosophical concepts of petroleum geology is Wallace Pratt's well-supported thesis that hydrocarbons can be expected to be present in nearly all sedimentary rocks. In his words, "We have learned that oil is a normal constituent of the marine sedimentary rocks all over the earth."

In searching for oil the petroleum geologist has mapped in considerable detail large regions which had previously been known only by reconnaissance or not at all. In his interpretations of the geology of new areas or areas not previously studied in detail, the petroleum geologist has sometimes added substantial proof and sometimes cast considerable doubt about existing concepts of sedimentation, stratigraphy, and paleogeology.

One publication which has probably influenced the work of the greatest number of petroleum geologists is the little volume **Field Geology**, by Frederic H. Lahee, now in its fifth edition. This book is believed to have more geology packed in it than any other American publication and has for a generation been accepted as the standard guide for field geologists as well as a text for students of geology in our colleges and universities. In the United States and a number of foreign countries it is used as a text by more than 100 schools of higher learning.

The Gulf Coast geosyncline, perhaps more thoroughly documented by well records than any other similar feature in the world, has been an area in which petroleum geologists have devoted much thought and careful study.

Dissemination of Information

Examples of structural interpretation by petroleum geologists both in the oil-producing regions and in virgin areas are legion in the bulletin of the association, as well as in the publications of other earth science societies.

The study of rock samples both from the surface and from wells has resulted in a large amount of petrographic information becoming available to industry and to educational institutions. Undoubtedly a large amount of petrographic information developed by petroleum geologists still lies unpublished in files of operating companies, but each year more and more of these data find their way into print, and eventually will become generally available.

There are fields of geological study to which I believe petroleum geologists have contributed more to our present knowledge than any other group. One relates to concepts of the movement of salt and the growth of salt-dome structures. The other is in that phase of subsurface stratigraphy which is principally based on micropaleontology.

From the date of their discovery in the Gulf Coast, salt domes have been the object of much study and speculation as to their origin, method of emplacement, age of the salt, and source of the minerals which form or are associated together in cap rock at the top of the salt mass.

In the field of stratigraphy, especially in the application of micropaleontology, petroleum geologists have been most active. Although foraminifera have been known for more than 2,400 years and studied in some detail the past 200 years, the impact of the petroleum industry has been so great that Hans Thalmann remarked at the S.E.P.M. meeting last year that "the last 20 years have yielded nearly as much in taxonomic units as the preceding 100 years before 1931." Foraminifera were first used to date strata in well bores in the Vienna basin about 1877 and presumably were first used in the United States by Frederick Chapman in California in 1896.

The petroleum geologist, as his understanding of oil occurence has increased, has been able to apply effectively the basic stratigraphic and structural principles established by the academic geologists. He has also devised new techniques such as thickness and facies mapping which have been valuable in interpretation of both local and regional geology.

Although it is natural to expect most of his interest to lie in strictly geologic considerations the petroleum geologist has had real influence upon develop-

*Vice president, Humble Oil & Refining Co., Houston. Past president of The American Association of Petroleum Geologists. Abridgement of presidential address to the joint annual meeting of the A.A.P.G., S.E.G., and S.E.P.M., Houston, March 24, 1953.

ments and applications and the trend of discoveries in other related fields. For example, as the knowledge of structure and stratigraphy grew, the demand for more critical subsurface data resulted in development of electrical logging instruments and of other tools, such as the dipmeter and side-wall coring devices. The early recognition by the geologist of the oil potentialities of areas where ordinary surface geologic techniques could not be used was largely responsible for the application of geophysics to oil finding. This has resulted in the continuing effort of the industry to improve the geophysical techniques and instruments which play such a prominent part in present-day exploration.

Teamwork Essential

No radically new exploration tool has appeared recently and industry continues to base its oil-finding effort almost entirely upon the various time-tried geological and geophysical methods. Since full reliance cannot be placed on any one of these methods in most areas, all have become established parts of exploration operations and are used in conjunction when necessary. Each method provides information important in the interpretation of local and regional geology and in many areas the coordination of the results of all of them provides industry with its surest means for finding oil. Such coordination cannot be properly realized without full cooperation of the entire exploration group, which includes physicists, mathematicians, chemists, and engineers, as well as geologists. Thus, teamwork is becoming increasingly essential and the petroleum geologist, with his background knowledge of stratigraphy and structure, and of the earth factors which may influence geophysical interpretations, occupies a key position on the exploration team.

It is noteworthy that as the geologist has continued to gather and marshal facts, his viewpoint on the abundance of oil and gas has become more and more optimistic. He now sees little chance that the supply of petroleum in the United States, or the world, will be depleted in the foreseeable future. For some years he has disagreed with pessimistic outcries which have stemmed from those who do not know, or have not properly considered, that the widespread occurrence of oil in sedimentary rocks is the rule and not the exception. The discoveries and additions to reserves for the past decade of unprecedented United States production amply support the better-informed viewpoint of the petroleum geologist.

Geologists' Activities

The special training and findings of the petroleum geologist have proved useful to the community as a whole in other ways than in oil finding, or in the advancement of scientific knowledge. Through his study and interpretation of drilling and other exploration data, he has been able to help in locating water supplies, foundation and building materials, brines, rock salt, potash, sulfur, clays, coals, radioactive minerals, and other mineral substances of economic and strategic importance. Through his initiative in exploring for and developing oil production in backward areas, transportation, communications, and educational facilities have been improved. By directing attention to relatively unexplored areas, essential geographic data have been provided, and in some cases primitive areas have been developed. As an advance agent it has been one of his privileges to introduce into many communities the progressive attitude of the petroleum industry.

In schools . . . That education in colleges and universities has been stimulated through the activities of the petroleum geologist is evident from the steady increase in the number of geology students over the years, and from the fact that more than half of the geological graduates have been enter-

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ing the petroleum industry. This interest in geology has resulted in the establishment of more comprehensive curricula in geology. Through recommendations of petroleum geologists, many industry-sponsored scholarships have been established and grants made for the purpose of advancing geological research and special studies.

Curiously, there has been a difference in attitude of colleges and universities toward the influence of petroleum geology in the profession. Midwestern, western, and southwestern colleges have realized that the majority of their geology graduates will enter some type of petroleum work and have attempted to equip them for such careers to the best of their abilities. This has resulted in a great awakening of interest in geology and a decided expansion of departments in these schools.

The same thing has been true in some of the eastern schools, though perhaps to a lesser extent. In some of our oldest schools of geology in the eastern states, however, there has been a certain reluctance to acknowledge the influence of the petroleum industry and its geologists upon general academic geology and its teaching. This undoubtedly reflects in large part a lack of understanding of the wide scope of geological research and activity in the petroleum industry. With the steady increase in contributions to the literature by petroleum geologists, both through our own bulletin and those of the G. S. A. and other organizations, and with closer association, there undoubtedly will be a realization that petroleum geologists as well as academic geologists are contributing significantly to the advancement of our science.

During emergencies . . . In times of national emergency the petroleum geologist has proved that he is particularly qualified to discharge important duties. During war he has been called upon to aid in planning campaigns by providing necessary information about surface formations, topography, inhabitants, vegetation, and climate. Probably the greatest direct application in World War II of his geological training was in the interpretation of air photographs. His highly developed abilities of observation and correlation also were especially valuable in intelligence operations during the last war.

The community in which the petroleum geologist lives also benefits from his specialized knowledge. For example, both through the A. A. P. G. and by activities of individuals interest in geology is being fostered; such organizations as the Boy Scouts are provided instruction, public libraries are given assistance in selection of books, and the establishment and maintenance of parks are encouraged. In fact, wherever geological or natural-science information has been required, the community has found that the petroleum geologist can be depended upon to help.

His Future and Obligations

During the last 30 years United States annual crude-oil production has increased from 560 million barrels in 1922 to 2¼ billion barrels in 1952 and in spite of this enormous withdrawal, our proved reserves of liquid hydrocarbons have grown from an estimated 5 billion barrels in 1922 (U.S.G.S.) to 33 billion barrels on January 1, 1953. The American Association of Petroleum Geologists has grown from a membership of fewer than 100 in 1917 to an estimated even 10,000 on April 1, 1953. The petroleum industry and its geologists have been busy and effective!

What about the future of this large group? And what about its obligations? The first question can be disposed of more quickly than the second. We have already noted that the whole process of exploration is becoming more complex. We have seen how the petroleum geologist's appraisal of the work at hand has sometimes led to the first recognition of many basic problems of exploration and to determining suitable approaches to their solu-

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tion. It is believed that this situation will continue and that only the properly trained geologist will have an adequate background to coordinate the geologic thinking and sound interpretation of geologic data which future exploration for petroleum will require.

It is believed the young geologist should bring to the petroleum industry a solid foundation of training in geology and related natural sciences, well leavened by knowledge and appreciation of the humanities and an understanding of the importance of the ability to work agreeably with his fellow men. In addition he should have full access to the advice and services of other specialists, such as chemists, physicists, biologists, engineers, economists, and lawyers. With these qualifications and skills and in this environment, it is believed that as far as we can see in the future our petroleum geologist will be needed and his services will be very much in demand.

And what of his obligations? Geologists, more than any other professional group in our country, are concerned with those natural resources which are irreplaceable; which once depleted are gone forever. It seems to follow, then, that geologists should be our greatest conservationists. In the earlier days of the petroleum industry, geologists were almost the only advocates of conservation, although not all geologists at that time, unfortunately, were so persuaded. In later years geological workers for conservation have been ably reinforced by the petroleum engineers. For the latter, it must be recorded to their credit that as their knowledge and appreciation of reservoir performance has increased, they have taken more and more of a leading role in conservation matters until now the geologist must look to his laurels else he will be displaced as the leading conservationist in the petroleum industry.

The entire background of training and experience of a petroleum geologist and his position of trust in many organizations and in many communities are such as to demand his wholehearted advocacy and support of all true conservation measures whether they be directed toward increasing ultimate recovery of an oil field through optimum production rates or whether they relate to scientific management of an aquifer on which a community relies for water. Less than full support of conservation may be regarded as betrayal of a trust.

The petroleum geologist has many present and future obligations to his industry, to society, and to the nation. Not the least of these is his duty to encourage and to further, as far as he can, the training of an adequate number of geologists and other earth scientists for the future. Only in this way can our future supplies of fuels and chemicals essential to our economy and national security be assured. There are many ways in which this can be done, but one of the most basic considerations for us to be concerned about is the question of whether our teachers of geology will be properly qualified and in sufficient numbers to do the job at hand. Is it not shortsighted for us to continue to pay our geological professors at rates so low that many are attracted from their chosen field to enter industry? It is not believed to be bad per se for professors to work for oil companies or petroleum geologists to become professors. On the contrary, some exchanges of this type are doubtless beneficial. It should, however, be a matter of real concern to the petroleum industry and petroleum geologists if universities are not properly staffed with geologic teachers possessing ability and vision, and if these trainers of our future exploration forces are not compensated adequately.

Hopes for the future in petroleum geology, like our hopes for the nation, rest upon our young men and women. Current graduates are academically better trained than ever before to cope successfully with the complex task of future petroleum exploration. They have fine instincts awaiting proper channels for expression. We of an older generation have a solemn duty to instill into these receptive minds an appreciation of the sturdy virtues and ethical precepts so treasured by the founders of our profession.

If, as confidently expected, we can succeed in our schools, our geologic societies, and our industry organizations in assisting our young geologists to develop a proper feeling of responsibility toward their professional obligations, including a realization that geological assignments nearly always involve relationships of trust, then considering their other outstanding talents and abilities, the future of our profession seems bright indeed. If we may paraphrase the words of Sidney Powers, it can be confidently said, "The contributions of the petroleum geologist will be more brilliant in the future than they were in the past and will continue as long as petroleum and its derivatives are required as fuel."

BOOK

A.S.M.E. UNFIRED PRESSURE VESSEL CONTROL CODE, Section VIII of the 1952 A.S.M.E. Boiler and Pressure Vessel Code. Published by American Society of Mechanical Engineers, 29 West Thirty-Ninth Street, New York 18, 183 pp. $3.50.

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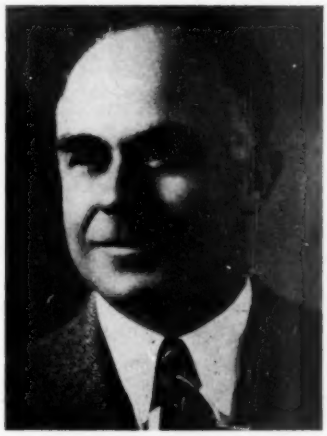
Our Human Assets in GEOPHYSICS



"... are many and varied, but along with them we are also heirs to the usual human faults which we must school ourselves to avoid. Among the worst of these are complacency and self-satisfaction; skepticism and prejudice."

by Curtis H. Johnson*

THE three societies represented here have a common purpose: oil finding. In the pursuit of this purpose they may achieve many other incidental goals; make many far-reaching contributions to the broad fields of geology and geophysics, and even to the fields of physics and chemistry. But the prime purpose toward which the efforts of most of the members are directed is still oil finding. On that we shall be judged.

In the pursuit of oil the important assets of geophysics, like those of geology, are its human assets. In a recent article[1] Wallace Pratt has used the term "oil finder" to embrace geologists and geophysicists alike in the following statement: "Where oil is first found, in the final analysis, is in the minds of men. The undiscovered oil field exists only as an idea in the mind of some oil finder. When no man any longer believes more oil is left to be found, no more oil fields will be discovered, but so long as a single oil finder remains with a mental vision of a new oil field to cherish, along with freedom and incentive to explore, just so long new oil fields may continue to be discovered."

Levorsen[2] has even gone so far as to say that our instrumentation may be a hazard to oil finding because too great a dependency on "mechanical crutches" may dull the ability of geologists or lessen their inclination to do "discovery thinking." However, thought breeds thought. It is the job of the geophysicist as an oil finder to provide a buffer of thought between the geologist oil finder and these so called mechanical crutches. It is equally the job of the geophysicist to practice discovery thinking to qualify as an oil finder.

Let us wipe out the misconception that the principal asset of geophysics is its instruments.

Oil-Finder Qualities

The geophysicist must be both the creator and the master of his machines. His instruments achieve nothing but what his human skill has built into them nor do they impart anything but what his human skill takes out of them.

Let us, then, take stock of our assets; see what they have done for us; what they can do for us in the future; and how we can nurture and expand them—realizing that they are all, in the final anlysis, human assets.

The human beings comprising our profession have individual qualities that have made and will continue to make oil finding a success. Let's consider some of these qualities as listed by some of our eminent writers, none of whom intended his list to be all-inclusive:

"Faith, persistence, the venture spirit, and vision," says Pratt. "Acuity and experience," says Wyckoff. "Performance in spite of skepticism," says Morgan. "Ingenuity, industry, interest, and common sense," says Gilmour. Then, to complete the quotations but by no means exhaust the literature, Levorsen has emphasized the ability to do "creative geology," which we might broaden to include "creative geophysics" or creative thinking in general.

As selected, these quotations omit such obvious necessary qualities of an oil finder as imagination, enthusiasm, curiosity, and courage — courage to "stick out the neck"; courage to admit mistakes.

Underlying all these qualities and implemented by them must lie the urge —the drive—to discover. Without this drive all latent abilities are wasted. With it even the beginner becomes an oil finder; the veteran's accomplishments astound.

But more homely qualities of our people must be counted among our assets; in fact, they are vital to our success. How much our success depends upon physical stamina; upon physical and mental prodigality. For 21 years I have been engaged in either geophysical-instrument design or geophysical exploration, working with others of my kind. I recall a changing panorama in the background but always, in the foreground, a man or a group of men laboring far into the night: deriving the final step in that elusive equation; making that last vital instrument check; taking that last important observation; picking that last fugitive reflection; or drawing that last all-important contour.

What of the home life of our men? How can our men spend their energy

*Assistant chief geophysicist, General Petroleum Corp., Los Angeles. Past president of the Society of Exploration Geophysicists. Presidential address to the joint annual meeting of A.A.P.G., S.E.G., and S.E.P.M., Houston, March 24, 1953.

figuring out how I can be of real help to all you well diggers down Corpus Christi way. ★ In all my years of drilling and servicing oil tools, I've never found anything that worked as safe and sure as those W:b Wilson Tongs—naturally with "Tiger Tooth" Tong Dies in 'em. ★ If you just can't wait till I get out to pay you a formal visit and tell you all about 'em, my name is Buckner—"Gene" for short, and a call to Corpus Christi 2-5361, or a line to Box 5306, will bring me a'flying!

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so freely in the pursuit of oil—uproot themselves so frequently to invade new areas—without disrupting their homes? Here let me sing a paean of praise to our wives. It is long overdue and richly deserved.

What other every-day virtues are essential to our success? Surely we depend upon common honesty and loyalty. We depend upon diligence and accuracy. We depend upon friendliness and courtesy.

Do we find all these virtues and the other qualities we have described in every member in our ranks? Let's not kid ourselves. We are not perfect. However, to the extent we possess them our chances for success increase. I do believe we have them to an unusual degree. People who don't have most of these qualities simply do not survive our rigors. There is a winnowing action which separates the grain from the chaff—a task which separates the men from the boys.

Oil-Finder Inheritance

No less significant than the qualities which make oil finders of individuals are the human assets we possess as a group.

Many of these are legacies from the past. Most of them we take for granted, but it is good sometimes to count our blessings and be thankful.

In the first place, we have inherited the scientific method upon which all our thinking is based and we have inherited a public acceptance of the scientific method as a respectable aspect of society. Can you imagine finding oil in an atmosphere of superstition and intolerance toward this method?

Secondly, we have grown at a time when the idea of a profession has been long established—a profession setting its own standards and providing a basis for cooperative understanding among its members. Our three societies sponsoring this meeting owe their existence to the fact that professions exist.

In the third place, we have inherited a confidence born of the past achievements of men in other sciences. As scientists we have been handed down a tradition and a habit of success.

Finally, and perhaps most importantly, we have inherited, in our part of the world, at least, a free society in which to do our work. Freedom to think and say what we please—to freely exchange ideas. Freedom to come and go—to let our search for oil carry us where it will. Freedom to direct or expand our investigations along paths of our choosing. We have the immeasurable benefit of working under a system of free enterprise and free industrial expansion based on a free market.

We dare not take all this freedom for granted. It is a precious thing which must be tended carefully to live. Our preoccupation with our science—with oil-finding itself—must not prevent our participation as good citizens in every activity which will keep us in the light of freedom.

Our human assets are many and varied, but along with them we are also heirs to all the usual human faults which we must school ourselves to avoid. Among the worst of these are complacency and self-satisfaction; skepticism and prejudice.

The old-timers among us remember a modification of the seismic method which was proposed and provoked great discussion 20 years ago. This was essentially a proposal to record unmixed, broad-frequency seismograms in reproducible form—thereafter reproducing them with as many choices of mixing and frequency limitation as the mind could conceive. In retrospect it would seem that we exhibited all the above human faults in rejecting this proposal, for today, 20 years later, the principle is being widely accepted and there is a rush to acquire equipment and operational experience with the method.

Based on this experience, where a 20-year period elapsed between a rejected proposal and final acceptance, one might make this prediction:

"Geochemistry, 20 years after its cold reception in 1940, will be revived and will receive wide acceptance as an oil-finding tool in 1960."

In my term of office I have had the opportunity of becoming very close to the men of our profession. We are rich in human assets. Let us realize that all assets are human, and so take full responsibility in our task rather than place it on the instrument or machine. Let us strive to put this idea across to industry management that our men may achieve dignity and rewards to spur them on. Let us sell this idea to people as a whole that we may receive the sympathy and cooperation of society. And let us do our part in society to insure the liberty we now enjoy.

And let us not forget that we, as humans, have failings which are not assets in oil finding or any other form of endeavor.

Our course of action is clear. We must recognize and strive to overcome our human shortcomings, and we must nurture, expand, and utilize to the fullest all our human assets. Only thus will oil continue to be found.

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1. Wallace E. Pratt, "Toward a Philosophy of Oil Finding," A.A.P.G. Bull., December 1952.

2. A. I. Levorsen, "Discovery Thinking," A.A.P.G. Bull., July 1943.

FORAMINIFERA

. . . an evaluation

Micropaleontology has proved its value as one of the oil-finding techniques which have made possible the production of several million barrels of oil daily.

by C. C. Church*

THE growth in the use of microfossils, particularly the foraminifera, has so paced that of the oil industry that for those who are familiar with it, the mention of one almost automatically suggests the other.

In the 33 years since the first laboratories were established in Texas, similar laboratories have become a regular adjunct of most of the larger oil companies throughout the world, and the number of workers engaged has increased from a mere handful to many hundreds.

The importance of the foraminifera and the need for basic research is answered by the combined efforts of oil companies, universities, governments, scientific societies, and individuals. Many of the large oil companies donate generously to scholarships in universities and research institutions as well as carry on research in their own laboratories. The emphasis being placed on ecology and sedimentation indicates a trend in interest toward the factors which have influenced the distribution, growth, and variation of foraminifera, and in the interregional comparisons of fossil assemblages.

Facies studies . . . Within the past few years the methods used in the search for oil have changed from those based primarily on indications gained from surface geology to those of subsurface evaluation by means of seismograph data, well logs, isopach mapping, reef study, stratigraphic traps, and facies trends. In these surveys the foraminifera are useful in age determination and as facies indicators. In the past, as is true today, they were living under all phases of ocean environment. There were those adapted to the living conditions in the brackish waters of bays and lagoons, others had adapted themselves to the shallow littoral zone while the greatest numbers and varieties were living in the comparatively equable climate of the waters of shallow to medium depth on the continental shelves. Finally there were some comparatively few living on the deeper shelves and basins. Most of them lived on the bottom, free or attached, but a great many, from the Upper Cretaceous period onward, were free-floating (planktonic) forms, following the ocean currents without regard to depth, sensitive only to temperature changes and food supply.

Indicative of the importance now placed in facies interpretation is the micropaleontological facies-log such as that described by A. ten Dam which is used in the laboratories of the Royal Dutch-Shell Oil Co. This log is so arranged that all of the environmental factors are taken into account to arrive at the probable ecologic niche for each sample. When this is applied to a series of field sections or core holes, a rather definite idea may be gained of lateral or vertical changes in the strata.

Interregional Correlation

For many years paleontologists have been aware that the planktonic or free-floating types of foraminifera possessed the characteristics which made them ideal for the purposes of correlation. They were independent of bottom conditions and subject to wide dispersal by the far-ranging ocean currents. From this fact all kinds of bottom sediment would receive a fraction of the planktonic foraminiferal tests. Where benthonic species were present, the two types would intermingle, but in the bathal areas, only the planktonic species would be present to form sediments similar to those we know today as globigerina ooze.

Correlations on a world-wide scale have long been accepted for the Pennsylvanian and the Permian on the basis of the fusulinids. These well-known larger foraminifera appeared in the Lower Pennsylvanian, underwent rapid evolutionary changes, and then died out rather abruptly toward the end of the Permian.

The value of the pelagic species throughout the Upper Cretaceous has been mentioned but the benthonic species were also very similar throughout the temperate regions of the world during the same period. From the Upper Cretaceous to the Upper Eocene the discocyclinas were abundant and progressed rapidly through many evolutionary changes. The miogypsinids include many short-range genera which lived only during Miocene and Oligocene time. The study of these faunas on an intercontinental basis has brought out the salient points of their ranges and relationships. A comparison of faunas from the west coast of North America with those from western South America and the Caribbean region reveals many striking similarities. Quite a number of species are common to all three areas and many more show genetic relationships. In the later Tertiary the similarities are

* Past president of the Society of Economic Paleontologists and Mineralogists. Condensation of presidential address to the joint annual meeting of the A.A.P.G., S.E.G., and S.E.P.M., Houston, March 24, 1953.

not so marked. This is believed to be due to the development of land bridges and the confining of marine invasions to marginal basins and bays, suggesting a stabilizing of the major portions of the continental areas in the late Tertiary.

The comparisons described above have been made possible by the international study of geologic sections and their faunas combined with a wider distribution of publications and a more general exchange of material and ideas.

Laboratory Techniques

Some of the original techniques employed in separating the foraminifera from the rocks are still in use, but many new methods have been developed to disintegrate the varying types of sediments. Some of the most effective of these were discovered by accident, others by well thought out procedure. Many elaborate and ingenious devices have been invented through the years and most of them eventually abandoned, as too time consuming, cumbersome, or ineffective.

In general, it has been found that the shorter the process and the simpler the mechanical device, the less chance there is for contamination. For the smaller foraminifera, the preparation of samples for study has thus resolved itself into a fairly simple, speedy, streamlined procedure of crushing, chemical treatment, boiling, and screen washing. This is often followed by a fractional heavy liquid separation after drying. The use of sodium carbonate and sodium hydroxide in treating siliceous and organic shales was an early development which is still much used. A more recent discovery described as early as 1942, by W. Wick, of Hamburg, Germany, is that of first saturating the dried and crushed sample with gasoline, decanting off the gasoline, and then soaking it in water. This method is often successful with highly compacted claystone and will probably become a standard method of treatment for refractory types of clay and shale. It is not effective with completely indurated or highly siliceous rock.

Another method of treatment developed and described by Wick, is the hydrogen peroxide treatment. In this method samples are crushed to a diameter of 1 cm. and less, then immersed in 15 to 20 per cent hydrogen peroxide. After 10 to 15 minutes, enough heat is generated to bring the sample to the boiling point and white, oxygen-rich vapor is given off. When the action subsides, the lumps of clay have been reduced to a mud and can readily be washed through the screens. This method, to my knowledge, has not been used in our own laboratories.

The methods just described apply to the so-called smaller foraminifera or those types which are classified by means of their outward shapes and surface ornamentation. Conversely, by the "larger foraminifera," we mean those forms which are large enough to be recognized without the aid of a microscope, that is, about 5 to 20 mm. in diameter and in which specific and generic determination is based on the internal structure of cells and walls. From this fact they are studied, almost exclusively, by means of thin sections in which the technique of preparation has not changed materially since it was started many years ago.

Needs of the Science

To imply that all of the problems which have arisen have been solved would be far from the truth. There is still a great need of a classification which a majority of paleontologists can use and agree upon.

The need for more illustrations of known faunas and the naming of new species has progressed, but is still retarded by the difficulties and expense of securing adequate illustrations. The need for a more general agreement on

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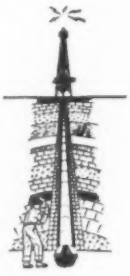

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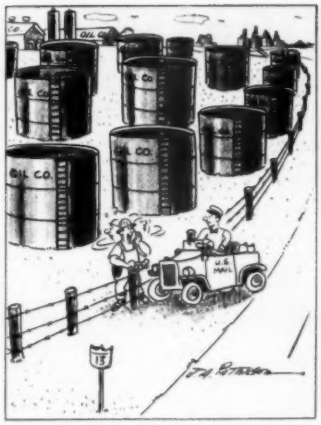
names of genera and species is somewhat less acute, but the concept of the dividing line between individual variation and species within a generic group will continue to be an individual matter. At the present time there is a tendency toward splitting rather than grouping the species.

The difficulties arising from the occurrence of different species under changing ecologic conditions within the same time interval can often be solved by the use of planktonic species or by a careful study of overlapping ecologic assemblages.

It would be greatly to the advantage of both economic paleontologists and the academic worker if there cou'd be a more general distribution of type material or type sets, but perhaps the work involved, and at times, the actual shortage of some species would prevent authors from achieving this goal even if they desired to do so. Meanwhile we can be thankful for the great Ellis and Messina catalog of the foraminifera, which comes about as close as possible to keeping up with the new names and in distributing the pertinent facts concerning them.

Manpower . . . The men who pursue this highly specia'ized branch of geology



"Well, I better get back to the old climbing —let's see, now, where was I?"

are now often referred to as "bug men" in the practical workday world of the field and rig. This term, no doubt, stemmed from a device of the paleontologists themselves in referring to the microfossils as "bugs." This is a short term, which in the field or laboratory eliminated the more unwieldy and esoteric names, and which could be applied to any small fossil. These men who work at the job of identifying the many different kinds of microfossils must spend many years in careful study and comparison and the work requires both patience and devotion. More men are needed to fill the growing demand and those students of today showing an interest and aptitude in that direction should be encouraged to follow it.

Few Hampering Traditions

From the earliest beginning of the oil industry the men who followed it have combined a mixture of the adventurer and the business man. The youthful industry had few hampering traditions so the oil man was free to try each promising new tool or idea. When micropaleontology was first tried out there was a great deal of skepticism, but oil men were willing to give it a fair tria'. When its value was eventually proved it was accepted like the many other advances which, through the years, have made the difference between the 3,000-ft. well of a few years ago and the 20,000-ft. hole of today, and the difference between a few thousand barrels of oil per day a few years back and the several millions produced today.

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SELECTED ABSTRACTS . . .

. . . of papers presented at the joint annual meeting of the American Association of Petroleum Geologists, the Society of Exploration Geophysicists, and the Society of Economic Paleontologists and Mineralogists, Houston, March 23-26.

A. A. P. G.

Subjects of General Interest

Oil Discovery Trends

PAUL R. SCHULTZ, Stanolind Oil & Gas Company, Tulsa.

EXPLORATION and discovery results during 1952 provide significant new data for the analysis of trends in petroleum discovery. Developments last year also made it necessary to reevaluate some of the discoveries of previous years. It has become evident that Scurry County will provide much less primary-recovery oil than formerly believed. The vast Spraberry region of Texas has lost most of its luster. The Williston basin has ceased to be a wildcatter's paradise and has begun to provide its share of dry holes. Do these events indicate serious trouble in discovering new reserves? Analysis of trends in oil discovery indicate that they do not. Examination of 1952 results in terms of the trends of previous years shows that new discoveries are being made according to established patterns. New reserves added in the next few years will depend chiefly on the rate of total completions. Reserves added per well drilled can be expected to be almost constant.

Other nonquantitative factors, such as the opinions of operating geologists, confirm the statistical picture of satisfactory discovery rates and adequate proved reserves in the coming years.

The Occurrence of Hydrocarbons in Recent Marine Sediments

P. V. SMITH, JR., Standard Oil Development Co., Linden, N. J.

THE failure of past investigators to detect liquid hydrocarbons in recent sediments has been used to support the widely held contention that petroleum does not form in sediments at the time of deposition of the organic source material. The preferred viewpoint has visualized burial of the original "complex organic matter" by several thousands of feet of overburden and the elapsing of several millions of years as requisites for its conversion into hydrocarbons.

An investigation of the nature of the organic matter deposited in recent sediments has resulted in the discovery of liquid hydrocarbons in a wide variety of marine muds. Paraffinic, naphthenic, and a variety of aromatic components have been detected. The quantity of free hydrocarbons has varied from 9-283 p.p.m. of dried sediments. Extrapolation of data obtained on a 106-ft. core taken from the floor of the Gulf of Mexico 7 miles off Grande Isle, La., would give an estimate of 4,500,000 bbl. of crude oil per cubic mile of sediments in this area. Since the concentration of hydrocarbons increases with depth in this core, the above is probably a conservative estimate.

The recent origin of these hydrocarbons has been established by carbon 14 analysis. Possible sources of the hydrocarbons are discussed.

Some Recent Developments in Well Logging

LOY M. CHARTER, Shell Oil Co., Los Angeles.

RECENT developments in logging are assisting materially in determination of lithology and evaluation of productive prospects of wells. The MicroLog and Microlaterolog delineate possibly permeable formations and under certain conditions may be used to derive porosities and formation factors. The limestone log is useful for computing porosities and formation factors of porous layers where very resistant adjacent formations distort conventional electric logs. The Laterolog and guard electrode log often indicate the resistivities of thinly bedded formations where conventional electric logs are of little value. The induction log has proved to be a reliable indication of formation resistivities in wells drilled with oil base mud. Radioactivity logging recently has been improved by scintillation crystal detectors and improved neutron sources, and a new system utilizing measurement of scattered fast neutrons offers promise. Continuous recording dipmeters are providing good results which assist greatly in geological control.

Setting of the Gulf Coast Geosyncline

HAROLD N. FISK, Humble Oil & Refining Co., Houston.

THE Gulf Coast geosyncline is the main structural element in the greater sedimentary basin of the Gulf of Mexico region. Its axis, as defined by gravity relationships, is roughly parallel to the northern Gulf shore, lying south of Houston and close to New Orleans, where more than 25,000 ft. of dominantly deltaic deposits of Cenozoic age and an unknown thickness of Mesozoic sediments are present. The inland limb of the huge down-warp comprises the thick wedge of post-Paleozoic sediments beneath the Gulf Coastal Plain and consists of a complex of secondary basins, local uplifts, and faults. Much less is known about the gulfward limb which underlies the Continental Shelf and extends seaward toward the center of the Gulf basin. The shallow-water character of late Cenozoic sediments penetrated to a depth of over 16,000 ft. in wells drilled near the edge of the continental slope, and the presence of submarine scarps on the slope indicate deepening of the Gulf basin by regional faulting in comparatively recent time.

The sedimentary framework of the geosyncline reflects great cycles of deposition and is closely interlinked with the tectonic development of the region. Each cycle began with an influx of terrigenous sediments to deltaic centers, reached its climax at a time of maximum delta outbuilding, and drew to a close as river-mouth sedimentation slackened and a shallow sea advanced across former deltaic plains. Thick accumulations of clastic sediments characterize the deltaic masses; these facies grade seaward and laterally into finer-grained, more calcareous, clastic and non-clastic shallow marine facies. During each cycle the axis of the geosyncline connected deltaic centers which were the areas of maximum downwarping; local uplifts and downwarps exerted secondary controls on its position. As the basin subsided, its inland margin was uplifted; consequently the geosynclinal axis shifted gulfward with each successive depositional cycle.

Despite the wealth of data available for interpretation, there is still much to be learned with regard to the character of the region prior to the formation of the greater Gulf basin, the age and origin of the salt, and the cause of geosynclinal subsidence. Some geologists and geophysicists still contend that the geosyncline does not exist.

Recent Geology of the Northern Gulf of Mexico Region

RUFUS J. LaBLANC and NORMAN N. GREENMAN, Shell Oil Co., Houston.

THE Recent epoch began with the retreat of the last Pleistocene glaciers, and through a study of its sediments, can be divided into an early rising sea-level stage and a late standing sea-level stage. Research on the Recent for the purpose of establishing criteria for recognition of depositional environments in ancient strata should be concerned primarily with the known environments and related facies of the standing sea-level stage since many environments of the early stage no longer exist.

Recent sediments of the northern gulf region are derived from pre-Cambrian to Quaternary rocks of over half the United States, and are deposited in alluvial rocks of over half the United States, and are deposited in alluvial valleys along the coast and in the gulf in four groups of environments:

1. **Continental** (stream meander belts, backswamps, and eolian plains).
2. **Deltaic** (distributary passes and interdistributary marshes and lakes).
3. **Coastal interdeltaic** (beaches, barrier islands, lagoons and marshes).
4. **Marine** (shelf, slope, and deep).

Characteristic differences exist between deposits of various environments. Meander belt deposits consist of: laminated point bar sands grading upwards into silts and clays; channel deposits of soft clays-silty clays with local sand masses; and natural levee silts. Intermeander belt backswamp deposits consist of uniform clays which merge seaward with finer and thicker organic-rich clays of the deltaic marshes which flank distributary channel sands. Coastwise the deltaic facies merge with thinner interdeltaic deposits of well sorted beach-barrier island sands and brackish-water lagoon and marsh facies of clays and clay sands.

Shelf sediments, coarser and more variable than those of other marine environments, consist of sands, silty clays, interlayered silts and clays, and homogeneous olive green or brown clays. Foraminifera and larger organisms are common. Homogeneous olive green or brown clays are typical of the upper continental slope; on the lower slope and in the Sigsbee deep light yellow-brown mottled clays are

characteristic. In the deep, these grade eastward into foraminiferal oozes. Silts, light cream-gray clays, and red clays also occur in the deep. Generally, foraminifera are the only organisms found in slope and deep sediments. Sediments from the topographic highs of the outer shelf-upper slope region consist of sandy foraminiferal oozes and biostromal-type accumulations; little or no clay is present.

Many similarities exist between Recent and Tertiary facies of the gulf region; therefore, results obtained from research on the Recent are directly applicable and notably useful in deciphering and better understanding the sedimentary framework of the Gulf Coast geosyncline.

Stratigraphy of the Coastal Plain in Southeastern Alabama, Florida, and Georgia

LYMAN D. TOULMIN and LOUISE JORDAN, Florida State University, Tallahassee.

THE floor beneath Coastal Plain sediments has been reached in wells along the southern margin of the outcrop area of the Paleozoic and crystalline rocks in Alabama and Georgia and in an area extending from southeastern Alabama and southern Georgia through the peninsula of Florida to the vicinity of Lake Okeechobee. Although wells more than 15,000 ft. deep have been drilled, the floor has not been reached in southwestern Alabama nor in the southern tip of Florida. A prominent high area of the floor in southern Georgia and northern Florida is known as the Peninsular arch.

Jurassic sediments have been encountered in at least 10 wells in southwestern Alabama but have not yet been positively identified in Florida and Georgia and are not discussed in this paper.

Lower Cretaceous sediments are present below Upper Cretaceous sediments from a short distance south of the Fall Line throughout the area under discussion except on top of the Peninsular arch. The series is at least 5,000 ft. thick in southern Alabama where it consists of variegated clastic deposits. It is more than 7,000 ft. thick in southern Florida where it is a carbonate-anhydrite facies.

The Upper Cretaceous series crops out in a belt across central Alabama and Georgia, and south of the outcrop area is present beneath the surface. It extends across the top of the Peninsular arch where it rests on Paleozoic rocks. On the northern flank of the arch the upper beds (of Navarro age) are missing. Nonmarine clastics in the lower unit (Tuscaloosa formation) in the outcrop area grade into marine clastics downdip. Marine clastics, chalk, and chalky marl overlie the lower unit in Alabama, Georgia and the panhandle of Florida. In the peninsula, the series consists chiefly of limestone and dolomite. The series thickens from about 1,000 ft. in northern Florida to about 2,700 ft. in southern Florida.

The Paleocene series consists chiefly of marine clastic deposits in southwestern Alabama and the panhandle of Florida, of limestone in southeastern Alabama, and of dolomite and anhydrite in the peninsula. The Eocene series consists chiefly of marine clastics with limestone at the top. In the peninsula the entire series is dolomite and limestone. The Oligocene series is predominantly limestone. It is absent in eastern Georgia and the eastern and central portion of the peninsula. The Miocene series consists of clastic deposits, chiefly marine. In Georgia and Florida the lower part is limestone. The Pliocene series consists entirely of clastic deposits which, in southern Alabama and western Florida, are of fluvial origin and elsewhere are marine. The coastal terraces have a mantle of Pleistocene marine sand and the stream terraces a mantle of Pleistocene fluvial clastics. Pleistocene limestone is present in southern Florida. Cenozoic deposits are less than 2,000 ft. thick over the Peninsular arch and reach a thickness of over 5,500 ft. in southern Florida.

Post-Eocene Sediments of Louisiana, Mississippi, and Western Alabama

LESLIE BOWLING and L. C. AYCOCK, Bowling & Claudet, New Orleans.

DISCUSSION is limited to sediments of Vicksburg age and younger in the coastal plain of Louisiana, Mississippi, and western Alabama.

A structural map on the top of the Eocene (Jackson formation) is presented to depict the "basement" on which the Oligocene and younger sediments were deposited.

Structural and isopachous maps of post-Eocene sediments are presented and discussed.

Stratigraphy and facies changes are related to depositional environment. Structural features within the basin are presented and are related to stratigraphy and environment.

Cross-sections are presented to illustrate the relationship of stratigraphy and structure.

Evidence of the General Structure Of the Gulf Coast from Geophysical Data

PAUL WEAVER, Gulf Oil Corp., Houston.

AFTER geophysical prospecting, principally with torsion balance and magnetometer, had attained a considerable coverage along the north side of the Gulf of Mexico the data available to Barton were interpreted by Barton, Ritz, and Hickey as evidence of a Gulf Coast syncline the trough of which lies near the present coast. Additional geophysical information, both from further gravity and magnetic surveys, and from reflection seismograph profiles, suggests that near the coast the structure is homoclinal, at least at the shore line and for some distance beyond it into the gulf. The information now available also indicates that there are no striking irregularities in the configuration of the basement across the coastal plain, nor evidence of intrusives, except along the interior margin and in Florida. The geophysical data yield information throughout the area to somewhat greater depths than have been drilled, and are believed to be sufficient to indicate that the sediments above the Louann salt in the Mesozoic and Tertiary are substantially concordant, except for the effects of the movement of the salt into domes. Such movements have resulted in local changes in sedimentation over and adjacent to the present position of the salt in these domes, as have been established by drilling, and which are a feature of certain portions of the Coastal Plain extending from western Alabama to the vicinity of Laredo in southwestern Texas.

Basin Areas of North America

Oil and Gas Prospects of the Delaware Basin, Texas, and New Mexico

T. F. HARRISS, Consultant, Midland, Tex.

IMPORTANT petroleum discoveries are in prospect for the Delaware basin, a buried Permian marine embayment, underlying more than 10,000 sq. miles of West Texas and southeastern New Mexico.

The Midland basin, another buried Permian embayment, is similar to the Delaware basin in many ways, and lies east of it, separated only by a buried shelf. In the Midland basin, large petroleum reserves have been found in Permian to Ordovician reservoirs.

In the much-less-explored Delaware basin, the only important production is from the so-called "Delaware sand" near the top of the Bell Canyon formation (youngest in the Delaware Mountain group of the Guadalupe series). Shallower Permian production, from the Rustler, Salado, and Castile formations of the Ochoa series, has been negligible in amount. Deeper Permian beds have not yet yielded sustained production, but this may follow recently indicated discoveries from sands deeper in the Bell Canyon and older formations of the Delaware Mountain group. In 1947, a quickly depleted well produced a few hundred barrels from a tight zone in the upper part of the Wolfcamp series (and possibly lowermost Leonard series). Strata of approximately the same age have recently yielded interesting shows in another part of the Delaware basin. To date, the only pre-Permian discovery is a shut in well reported to have tested dry gas at the rate of 10 million cubic feet daily from a cherty zone of doubtful, possibly Devonian, age.

Current exploration in the Delaware basin is adding to Delaware sand reserves, particularly in the northeastern part of the Tunstill-Mason trend; and sustained production from deeper zones is imminent. The most important discoveries are expected to result from prospecting all pre-Permian reservoirs within reach of the drill, down to and including the Ellenburger dolomite of early Ordovician age.

Tectonics and Its Relation to Oil and Gas Production in the Four Corners Area of New Mexico, Colorado, Arizona, and Utah

PAUL H. UMBACH, Consultant, Albuquerque, N. M.

THE type of sediments deposited as a result of geoanticlines, geosynclines, local embayments, and uplifts is of major importance.

Sediments indicate the intensity of the uplifts, some of which have been active since at least the Devonian period.

The large number of successful wildcat wells drilled for stratigraphic traps as a result of detailed study of the sediments compared with the success of wildcat wells drilled on anticlinal structures without regard to the types of sediments in the Four Corners area indicates that a study of the changes in the type of sediments is more important than the mapping of local anticlinal structures.

A study of the type of sediments and the location of anticlinal structures with the seismograph within the areas having sediments favorable for oil and gas reservoirs will be the key to future success in the drilling of wildcat prospects in the Four Corners area.

S. E. P. M.

Finding Ancient Shorelines

Continental Shelf Sediments Off the West Coast of Florida*

HOWARD R. GOULD and ROBERT H. STEWART, U. S. Geological Survey, Sarasota, Fla.

STUDIES of the Continental Shelf sediments along the northern and eastern coasts of the Gulf of Mexico have shown that the sediments off the west coast of central

Florida differ from those off the coast of northern Florida and Alabama. Off the west coast of central Florida, the sediments occur in six zones roughly paralleling the coast. The innermost zone has an average width of about 15 miles, and its sediments are composed chiefly of detrital quartz, with phosphorite grains abundant locally. Those sediments of the innermost zone are similar to the sediments of the adjacent beaches and to the sediments carried by rivers entering the gulf, which suggests that the sediments were derived from these sources. The five outer zones, combined, have an average width of 100 miles and their sediments are largely organic.

Off the coast of northern Florida and Alabama, quartz is the dominant constituent of the sediments for a distance of about 50 miles from shore. The greater seaward extent of detrital sediments in this area probably results from the higher relief of the adjacent land mass and from the entry of larger streams into the gulf in this region.

The faunal changes off central Florida are about the same as those off northern Florida and Alabama, as determined by O. L. Bandy.

The results of these investigations, when applied to the problem of locating ancient shorelines, seem to warrant the following conclusions:

1. Where the adjacent land mass has low relief and little surface drainage, the detrital marine sediments are limited iin extent and quantity, and are mineralogically similar to the beaches and less soluble components of adjacent land areas.

2. Conversely, where the adjacent land mass has moderate relief and large through-flowing streams, the detrital marine sediments are great both in quantity and areal extent but may not be mineralogically similar to adjacent beaches and land areas.

3. Gradations in microfauna are similar in both environments mentioned above, and they should be equally helpful in locating ancient shorelines in both of these environments.

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* Publication authorized by the director, U. S. Geological Survey.

Distribution and Origin of Sediment Units in the Eastern Mississippi Delta

P. C. SCRUTON, Scripps Institution of Oceanography, La Jolla, Calif.

THE basic factor leading to the development of a river delta is a large excess in rate of supply of sediments over rate of removal. Local variations in the relationship between these rates for different kinds of sediments result in the formation of sedimentary units with different characteristics.

The local variations tend to persist laterally and in time, so that three-dimensional units are formed. Migrations of the local variations (or environments) with delta growth lead to the formation of units of large areal extent which appear to bear predictable relationships to each other. The most important lithologic units which have been recognized in the Eastern Mississippi Delta entirely associated with delta growth in order of seaward occurrence are: marsh deposits, delta front silts, pro-delta muds, and offshore clays. Where other influences do not interfere, these units are deposited approximately concentric to the pass mouths, and their characteristics apparently depend to a large extent on the distance from the source.

In addition a sand unit is being deposited north of the active delta through the action of southwest-flowing longshore currents. Another unit, marginal muds, occurs between pro-delta muds and the sand and exhibits characteristics transitional between those of the sand and the pro-delta mud. Understanding of the processes of formation and the three-dimensional relationships of the units which result is necessary in order to interpret the stratigraphic column being formed in the delta.

Dynamic Geology of the Modern Coastal Region, Northwest Gulf of Mexico

ALAN LOHSE, Shell Oil Co., Corpus Christi, Tex.

THIS study is concerned with the relationship of the physiography to the dynamic geology and Modern sediments. The area of investigation is a belt along the Gulf Coast whose breadth is from the 10-fathom contour in the Gulf of Mexico to the line joining the landward edge of the principal lakes and bays, and which extends from Calcasieu Lake, Louisiana, to the south flank of the Rio Grande Delta, Mexico. Within this belt of the coastal plain are examples of lagunal, deltaic, tidal flat, littoral, and shallow-neritic environments exhibiting fresh-water, marine, and euximic conditions.

Tectonic forces produce the primary features: alternating deltaic and interdeltaic areas. The latter consist of the coastal lake-and-bay regions such as the area which extends from Matagorda Bay to the upper Laguna Madre between the Brazos and Rio Grande deltas. Tertiary counterparts are shale embayments.

The bays, lagunes, barriers, passes, and the sandsheet in Southwest Texas are the secondary features. They reflect a delicate adjustment to the physiochemical environment.

The principal agent of the physical environment is the surface wind. In addition to normal windwork it controls the waves, nontidal currents, and the coastal-drifting processes. These distribute the sediments and shape the secondary features. When analyzing the importance of the wind a distinction must be made between **prevailing** winds, which blow most of the time, and **predominant** winds, which expend the greatest amount of energy and usually do the greater amount of geologic work.

Particle-Size Distribution in Nearshore Environments

D. L. INMAN and T. K. CHAMBERLAIN, Scripps Institution of Oceanography, La Jolla, Calif.

THE patterns of the areal variation in the distribution of sediments from several beach and near-shore environments along the California and Gulf of Mexico coasts have been studied. A detailed investigation was conducted on a closely-spaced grid in one of the areas. Sufficient areal and seasonal samples were obtained so that the characteristics of the distribution of particle size with time and distance could be determined. In general it was found that seasonal changes in the sediments were not of sufficient magnitude to overshadow properties that can be attributed to the location or environment of deposition of the sediment. The investigation also indicated that the most satisfactory technique for studying the relation of particle size to environment utilizes a three-dimensional plot of the basic statistical parameters, median diameter, standard deviation measure, and shewness measure.

The findings and techniques from the detailed studied area have been used with success in more complex localities such as the embayments along the Texas Coast and in the Mississippi Delta region. Several types of sediment have been established on a basis of particle-size distribution, and these types have been correlated with the various nearshore environments. For example, the beach sands were found to be among the coarsest and best sorted material in each area, while samples from localities where two distinct sediment types mix, show a pronounced positive skewness and are poorly sorted.

General Paleontology

Age or Biofacies Correlation In Petroleum Geology

W. T. ROTHWELL, Richfield Oil Corp., Long Beach, Calif.

TERTIARY basins along the Pacific Coast of North America show lateral faunal changes in the same formation, reflecting differences in such ecologic factors as depth of water, distance from shore, composition of sediment and abundance of food. Distribution studies of living ostracodes and published ecologic data on foraminifers and fish provide a sound basis for paleoecologic interpretation of fossil faunas encountered in petroleum geology. Fossil fish scale genera serve as useful checks on ecologic environments of the early Tertiary Foraminifera, the species of which are extinct or distantly related to living species. Ecologic "biofacies" zones have been used widely in local California stratigraphic correlations as "time zones," but, viewed regionally, these often prove to be of little age significance with change in geographic position in a basin. Surface sampling, coring, and close cooperation between paleontologist and field geologist promote detailed data with which well cuttings can be correlated in working out facies problems.

Zonation of the Ocala Group in Peninsular Florida

HARBANS S. PURI, Florida Geological Survey, Tallahassee.

REGIONAL studies of the Ocala limestone justify the use of the term Ocala group, which is redefined to include all calcareous sediments of Jackson age that occur east of Tombigbee River. So defined the group includes the following formations: Inglis, Williston, and Crystal River. The Inglis and the Williston were both originally described as members of the Moodys Branch formation, but are here raised to formational rank because of the distinctiveness of their lithology and fauna, and because of their lithologic differences from the type Moodys Branch. The name Crystal River formation is proposed for the 108 ft. of limestone exposed in the Crystal River Rock Co. quarry, Section 6, Township 19 South, Range 18 East, Citrus County, Florida. It includes all calcareous sediments of upper Eocene age lying stratigraphically between the Williston formation and the overlying Oligocene limestones.

Reclassification of the Miocene of the Florida Panhandle

HARBANS S. PURI, Florida Geological Survey, Tallahassee.

IN the standard Miocene section of western Florida, there has been considerable doubt as to the sequence of the various formations. This may be attributed to the scattered outcrops, the homogeneity of the sediments, lack of data on the strike, dip, thickness and struc-

ture of these beds. Stratigraphy was based entirely on supposed faunal evolutions, disregarding lithofacies, biofacies, lithotopes and biotopes.

The present study embraces Okaloosa, Walton, Holmes, Washington, Bay, Leon, Jackson, Calhoun, Gulf, Liberty, Franklin, Gadsden, and Wakulla counties. Samples from 58 outcrops and 20 auger holes and water wells were studied. Structure sections and faunas of the Miocene indicate the presence of a number of lithofacies and biofacies, which are a measure of recurrence of similar conditions, and are reflected in both the lithology and fauna. Similar depositional types are considered as magnafacies, while dissimilar components within them are designated as parvafacies. These patterns, resulting from shifts in time and space distribution of environments, coincide with formational boundaries. Three magnafacies are recognized (Tampa, Chipola and Choctawhatchee).

Sedimentology

Faunas, Facies, and Tectonics

L. L. SLOSS and W. C. KRUMBEIN, Northwestern University, Evanston, Ill.

THE principle of lithologic associations related to environment and tectonics has been investigated and illustrated by a number of workers. Further examination of these associations and their fossil components suggests a parallel grouping of biologic associations. The manner in which these may be analyzed include the following:

1. Environmental indicators in the biologic complex.

2. Lithofacies, distribution, and isopachs of the associated strata.

3. Interrelationships between lithic and faunal patterns.

4. Evaluation of the relative influence of depositional environment and tectonic state on the observed associations.

Inherent in this approach is the necessity for identification, differentiation, and mapping of units of strata defined by environmental factors. These may coincide with or transect rock and biostratigraphic units.

The problems of biologic associations are illustrated by examples from the Paleozoic and Mesozoic.

Sedimentary Framework of the Modern Mississippi Delta

H. N. FISK, E. McFARLAN, JR., Humble Oil & Refining Co., Houston.

C. R. KOLB, U. S. Waterways Experiment Station, Vicksburg, Miss.

L. J. WILBERT, JR. consulting geologist, Monroe, La. (Presented by E. McFarlan, Jr.)

THE main sedimentary units in the bird-foot delta of the Mississippi, as disclosed by borings, closely correspond to the principal depositional environments. The distributaries (passes) are underlain by "fingers" of fine sand and silt approximately 200 ft. thick and 5 miles wide. These fingers pinch out laterally into relatively sand-free, brackish water clay "wedges" which underlie interdistributary troughs. Both sand fingers and clay wedges grade seaward into prodelta marine clays and are underlain by a 300-foot-thick stratum of these clays.

The growth of the delta is controlled by the progradation of the distributary mouth bars. A cone-like bulge of the gulf bottom, the submarine extension of the bars, slopes away from the mouth of each distributary. Each cone has approximately the same width as a sand finger, and the depth of the break in slope at its toe at 120 to 200 ft. approximates the thickness of a finger. As the bars build seaward, the passes lengthen and create the interdistributary troughs. These fill with clay and fine silt, the topmost layers of which are natural levee and marsh deposits, 5 to 20 ft. thick.

Using information from borings, maps dating back to 1839, and hydrographic surveys, it is possible to establish the rate of seaward extension of the Southwest Pass bar. By projecting this rate into the past, it was determined that the present bird-foot delta started to form approximately 400 years ago.

Nature and Origin of An Oligocene Sandstone Reservoir

R. H. NANZ, Shell Oil Co., Houston, Tex.

THE character, distribution, and probable genesis of a typical lenticular oil-bearing sand body of the Gulf Coast Tertiary, namely Zone 19B, and Oligocene sand of Seeligson field, Texas, was determined for the purpose of developing and defining criteria by which such sand bodies can be readily identified and delimited in the subsurface.

The stratigraphic framework was specified by cross-sections, fence diagrams, isopach maps, and facies maps, prepared from electric logs and core descriptions, and the sediments were characterized by size, shape, thin-section, X-ray, differential thermal, and chemical analyses.

Principal results are: (1) the isopachal trend of the sand body is nearly normal to the regional depositional strike; (2) the sand grades from medium grain at the base to fine at the top and can be divided into three zones on maximum grain size; (3) a typical specimen is a mixture of (a) well-sorted sand, the framework size fraction, (b) interstitial clay, the tail of the size distribution curve, and (c) interstitial calcite cement; (4) the mineral composition is similar to that of a modern river sand, but dissimilar to that of beaches, of the same geological province.

The sand body is probably an Oligocene alluvial-plain deposit as indicated by its similarity to such Recent deposits in external form, vertical textural zonation, colors of associated shales, mineralogy, and presence of mud fragments.

Down-Wind Clastic Limestones as a Key to the Location of Buried Reef Knolls

JOHN W. HARRINGTON, JAMES K. LILES, EDWARD L. HAZELWOOD, LANE E. HORSTMAN, HOWARD E. JACKS and NEAL NEECE, JR., Lone Star Producing Co., Dallas.

HULLDALE field in Schleicher County, Texas, occupies a typical Strawn reef knoll on the East Side Shelf of the Midland basin. A limestone bed tangent to the knoll extends with an obtuse delta shape from this point many miles to the north, east and south. This bed is believed to be a clastic limestone formed after reef growth time and laid across the then filled back reef lagoon. The hypothecated origin is that wave and current action spread a down-wind detritus shoreward towards the Concho arch. Then with this as a growth platform biogenetic development added to its thickness. This is requisite because the total volume is many times that of the knoll to which it is attached. Similar structures are illustrated from the Recent reefs of Australia and a Mississippian reef knoll near Alamagordo, N. M.

The importance of the concept is that by recognizing this structure in the subsurface, the existence and up-wind position of an attached knoll are implied. Paleo-wind vectors may perhaps be obtained by analysis of the lateral distribution and thickness of the layer. Caution is urged in employing these criteria because the key beds are known to extend for as much as twenty miles. Theoretically there might be only one attached knoll and this should be at the most windward point.

The paper is an illustration that paleoenvironment studies will play increasingly important roles in future petroleum exploration.

Sedimentary Petrology

Petrophysics of the St. Peter-Simpson Formations

E. C. DAPPLES and H. A. SLACK, Northwestern University, Evanston, Ill.

SEDIMENTARY accumulation within stable Cratonic areas commonly includes widespread or "blanket" sheets of sandstone typical of the "pure quartz" type. Such thin sheets of sand are important sources of information bearing on the depositional hydrodynamics, the tectonic condition and nature of the source. In the United States the best known example is the St. Peter sandstone (Chazy and Blackriveran, Ordovician). A knowledge of the characteristics of such widespread sand sheets is important in isolating the factors considered responsible for their occurrence.

The writers have developed the physical characteristics of a typical "blanket" sand from a series of maps including isopachs, lithofacies, packing and cementation (formation factor) and particle size ranges. The body of sandstone studied is restricted to the St. Peter and Simpson formations ranging from localities where sandstone dominates the lithology to the marginal areas to the west, south, and east where the limits of sandstone deposition merge into shales and carbonates. Features discussed are:

1. Areal dimensions of the sheet and consideration of the probable limiting size of such blankets.

2. Volumetric assay of the sand sheet.

3. Variation of formation factor as determined from resistivities given by electric logs.

4. Postulated physical conditions of deposition with the progress of time.

Diagenesis of Some Pennsylvanian Limestones of New Mexico

RAYMOND SIDWELL and G. F. WARN, Texas Technological College, Lubbock.

THE Pennsylvanian sediments in Upper Pecos Valley, New Mexico, represent two formations: 1. Sandia (lower); Madera (upper). They constitute the Magdalena group. The Sandia has been divided into a lower limestone member and an upper clastic member. The Madera has been divided into a lower gray limestone member and as upper arkosic member. Four Tectono-environmental conditions are represented. Each environment corresponds to a distinct member: the lower limestone member of Sandia represents a borderline Epineritic-Infraneritic environment on an unstable shelf; the upper clastic member of Sandia represents the fluvial-lacustrine-eolian environment on an unstable shelf; the gray limestone member of Madera represents the infraneritic environment on slightly un-

stable shelf: the arkosic limestone member of the Madera represents a transitional environment on an unstable shelf bordering actively rising highlands.

Texturally, three varieties of limestone are distinguished: (1) microcrystalline or granular, more than 50 per cent of the rock granular; (2) crystalline, composed chiefly of sutured anhedra; (3) fragmental, composed mainly of calcite fragments, quartz and organic remains. Diagenesis in limestone units is highly localized. Some units are practically bypassed, others are congenial hosts. Limestones especially susceptible to metasomatic replacement include the thin to medium bedded crystalline and fragmental varieties. Thin sections and photomicrographs show that diagenesis of various constituents of the limestone follows a definite sequence: (1) for carbonates, aragonite (or calcite) to calcite to dolomite; (2) for silica, opal to chalcedony to quartz. Many of the granular limestones result from repeated secondary growths of calcum carbonate on microscopic grains. Granular limestone may become crystalline, and eventually alter to dolomite. Fragmental limestones are abundant in the upper Madera. They frequently show secondary growths and partial to total replacement; hence they may become partly crystalline in texture. Diagenesis tends to increase porosity in the carbonates and to decrease it in the silicates.

Petrogenesis of Lower Pennsylvanian Sandstones of Eastern Interior Basin*

RAYMOND SIEVER, Illinois State Geological Survey, Urbana.

THE key to the origin of the sandstones of the Caseyville and Tradewater groups (together formerly the "Pottsville") lies in the detailed quantitative study of three parameters: (1) mineral composition, (2) textures, and (3) stratigraphic variation. Samples have been collected from outcrops and drill holes in Illinois, Missouri, Iowa, Indiana, and eastern Kentucky. Petrographic examination included thin-section study, heavy mineral analysis, and clay mineral analysis. In addition, numerous subsurface stratigraphic sections from all parts of the basin have been studied.

The spatial distribution of the various facies of these rocks is genetically related to the tectonic subprovinces of the basin such as the deeply subsiding central portion in southern Illinois, the relatively stable marginal areas in western and northern Illinois, and smaller areas delimited by major flexures in the basin, the largest of which is the La Salle anticline. On a smaller scale there is extreme lateral variation in thickness and gross lithology of beds, which is primarily related to the physical characteristics of the environment of deposition and the transporting agent, and secondarily to minor local control of sedimentation by smaller structures in the basin. Vertical facies changes, as well as the mineral composition of the sandstones, are primarily related to the over-all tectonic control, in particular to the tectonics of the source areas.

A wide variety of sandstone types is present in these two stratigraphic groups. They range from clean orthoquartzites to "washed" subgraywackes and true subgraywackes. They include some conglomerates containing well rounded quartz pebbles and some containing poorly rounded locally derived material. The general mineral composition of the sandstones and, in particular, the varietal types of detrital quartz are related to the composition and degree of tectonism of the source areas.

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Diagenesis of Some Pennsylvanian Sandstones of New Mexico

G. F. WARN and RAYMOND SIDWELL, Texas Technological College, Lubbock.

SANDSTONES are represented in each of the four Tectono-environments of the Pennsylvanian. The lower limestone member of the Sandia formation (borderline epineritic-infraneritic environment) contains two sandstone units, basal and medial. They are gray to greenish gray, associated with arenaceous limestones and are less than 10 ft. thick. The mineral content includes well rounded quartz, chert fragments, partly rounded mica flakes and a few grains of highly altered feldspar. The sandstones of the clastic member of Sandia (fluvio-lacustrine-eolian environment) are of two varieties, subgraywacke and quartz-oze. They are varicolored, medium bedded to massive, and are less than 20 ft. thick.

The mineral content includes an abundance of angular quartz, hexagonal mica flakes, a minor amount of partly altered feldspar and a few fragments of phillite. Locally, some of the sandstone units are associated with coal cyclothems. Sandstones in the gray limestone member of Madera formation (Infraneritic environment) are chiefly subgraywacke. They are gray to brownish gray, medium bedded, and are associated with a sandstone-shale-limestone sequence. The minerals in order of abundance are angular to subrounded quartz, hexagonal flakes of muscovite and biotite, and a few grains of feldspar. The sandstones in the arkosic member of Madera (transitional environment) are red to green, lenticular, poorly sorted, arkosic and conglomeritic. They are associated with red and green shales, micaceous silts and fragmental limestones.

Feldspars, micas, especially biotite, and silica minerals are susceptible to metasomatic alteration. The feldspur, chiefly plagioclase and orthoclase, alter to and are replaced by irregular aggregates of calcite, small transparent mica flakes (probably sericite), fibrous silica and kaolinite. Theiron-magnesium mica is commonly bleached and further disintegrates into kaolinite-like scales. Diagenetic changes in silica minerals include overgrowths on quartz grains and alteration from opal to chalcedony to quartz.

S. E. G.

Evidence of the General Structure Of the Gulf Coast From Geophysical Data

PAUL WEAVER, Gulf Oil Corp., Houston.

AFTER geophysical prospecting, principally with torsion balance and magnetometer, had attained a considerable coverage along the north side of the Gulf of Mexico, the data available to Barton were interpreted by Barton, Ritz, and Hickey as evidence of a Gulf Coast syncline the trough of which lies near the present coast.

Additional geophysical information, both from further gravity and magnetic surveys, and from reflection seismograph profiles, suggests that near the coast the structure is homoclinal, at least at the shoreline and for some distance beyond it into the gulf. The information now available also indicates that there are no striking irregularities in the configuration of the basement across the coastal plain, nor evidence of intrusives, except along the interior margin and in Florida.

The geophysical data yield information throughout the area to somewhat greater depths than have been drilled, and are believed to be sufficient to indicate that the sediments above the Louann salt in the Mesozoic and Tertiary are substantially concordant, except for the effects of the movement of the salt into domes. Such movements have resulted in local changes in sedimentation over and adjacent to the present position of the salt in these domes, as have been established by drilling, and which are a feature of certain portions of the Coastal Plain extending from western Alabama to the vicinity of Laredo in southwestern Texas.

Problem Areas for the Seismologist

GLENN M. CONKLIN, Sun Oil Co., Dallas.

INTERPRETATIVE problems encountered in four widely scattered areas, South Florida; Beaver County, Oklahoma; the Plainview basin of the Texas Panhandle; and Hancock County, Mississippi, are discussed.

Secondary refraction records, shot in Okeechobee County, Florida, offer problems because of the low-velocity energy being sustained for long periods of time. This low-velocity energy distorts and obliterates the high-velocity events.

Velocity problems due to differential salt solution in the Blaine-Cimarron interval in Beaver County are considered. Records are shown which illustrate the distortion of events and the resultant problems.

Multiple reflections give trouble in the Plainview basin of the Texas Panhandle. Record sections showing the many multiples are shown and discussed.

Multiple reflections in Hancock County, Mississippi, are discussed and record sections and cross-sections are shown.

Some suggestions for the treatment of the problems are advanced.

A Velocity Function Including Lithologic Variation

L. Y. FAUST, Amerada Petroleum Corp., Tulsa.

THE goal of this investigation was the development of a formula capable of predicting velocity from well logs with the same accuracy attainable by direct measurement. A tentative lithologic parameter was developed using values obtainable from electrologs. A relationship between velocity, depth, geologic time, and the lithologic parameter was determined from a study of these quantities in nearly a million feet of section measured in 150 velocity surveys.

The application of the formula in the prediction of vertical travel time indicates that, while the results are encouraging, the goal has not been reached. A study of the errors seems to show that this end might be accomplished in one or two ways: The more complete approach will require the aid of electrolog experts. A practical solution may be presently at hand but would require the cooperation of other velocity investigators.

Geophysical Progress

HENRY C. CORTES, Magnolia Petroleum Co., Dallas.

MARKED progress has been made in the amount of geophysical activity, in the number of new oil fields discovered per

year based wholly or partially on geophysics, in geophysical techniques, and in education. Improvements in instrumentation, field operational procedures, and interpretation methods have steadily increased the usefulness of the three major methods—seismic, gravity, and magnetic. The development of the aerial magnetometer, especially, and the underwater gravimeter, represent notable achievements. These developments have made possible the extension of geophysical activity offshore, and in many other areas previously considered inaccessible.

Research, both fundamental and applied, is being conducted on a greater scale now than in 1940 or prior thereto. Increased geological-geophysical coordination has led to better appreciation and utilization of the geophysical methods and has resulted in the discovery of important oil and gas reserves.

Novel or more direct oil-finding methods may possibly be discovered or perfected. It is more probable, however, that the future of exploration geophysics will be primarily in the continual refinement of the presently known methods. Advances in exploration geophysics and geology, along with teamwork, should insure adequate production and reserves within the United States for a long period. This is predicated on our nation having competitive free enterprise, which has been responsible for the leadership of this country in oil finding, producing, transporting, and refining techniques.

Wavelet Contraction, Wavelet Expansion and the Control of Seismic Resolution

NORMAN RICKER, Carter Oil Co., Tulsa.

THIS paper discusses the transmission characteristics of seismic apparatus for distortionless reproduction of seismic wavelets. It is shown that, by suitable design of seismic apparatus, the individual wavelets which go to make up a seismogram may be contracted or expanded without altering the relative arrival times of the wavelet centers. By means of this procedure the resolving power of the seismic apparatus may be increased or decreased at will, within certain limits. Laboratory studies of the performance of the wavelet contractor are described and field seismograms made with the wavelet contractor also are displayed.

Developments in Continuous Velocity Logging

R. A. BRODING, G. C. SUMMERS, and J. O. ELY, Magnolia Petroleum Co., Dallas.

COMPARISON of velocity data derived from continuous velocity logs with those obtained by conventional geophone surveys indicates that with the present improved velocity-logging instruments, an accuracy of the order of 1 per cent can be achieved in determination of total travel times from these logs. A simplified field procedure eliminates the need for a seismic crew on such surveys if the travel time to some point a short distance below surface casing can be obtained by the gun-perforator technique.

Comparison of velocity with electric and radioactivity logs indicates that in general there is a lack of evidence to support the correlating of the elastic properties with electrical or natural radioactivity properties of rock. Examples of unrelated velocity and electrical resistivity contrasts illustrate the hazards of deriving velocity data from resistivity logs. The lack of correlation between velocity logs, core analyses, and neutron logs suggests the hazards of correlating porosity or fluid content with velocity. The good correlation that is often observed between an acoustic transmission amplitude log and the neutron log suggests that fluid content may be controlling the transmission amplitude log.

The MicroLog Continuous Dipmeter

PIERRE DE CHAMBRIER, Schlumberger Well Surveying Corp., Ridgefield, Conn.

SOME of the methods used at the present time for the determination of the angle and the azimuth of the dip of the formations traversed by a bore hole are based on the correlations between three curves recording certain electrical characteristics of the formations, such as S.P. or resistivity, along the wall of the bore hole in three equally spaced azimuths. With the conventional equipment used for the application of these methods, the measurements are made over separate intervals of depth.

In the present paper, a new improved instrument called MicroLog continuous dipmeter is described, wherein the three curves used for the determination of the dip are obtained with three MicroLog devices, and wherein these three dipmeter curves, orientation of the instrument and the inclination of the bore hole are simultaneously and continuously recorded.

It is shown that, with the help of this instrument, numerous dip determinations can be made in a given well, with a higher accuracy and a greater recording speed.

Aerial Shooting for Seismic Exploration

J. J. JAKOSKY, International Geophysics, Inc., Los Angeles.

THIS paper describes a new technique for air shooting which has recently entered commercial seismic operation.

The first part of the paper presents a brief historical resume of early work by prior investigators in the use of explosives placed at a height above the earth. The initial proposals utilized explosives at a height comparable to the depth of the reflecting bed below the surface. More recent work utilizes explosives placed within a few feet of the surface of the earth to utilize the supersonic wave energy.

The subject technique uses an explosive bomb which is ejected vertically from a mortar placed on the surface of the ground. The bomb is exploded at a specific height, which is a function primarily of the spread length and near-surface ground velocity, in order to minimize the detrimental effects of ground roll and reverberation which have created such serious obstacles in previous air-shooting techniques. The apparatus and bombs, and general theoretical factors are described.

Records are shown from different surveys comparing the recordings from in-hole shooting with air shots at the same shot point, at various difficult drilling areas in the United States.

The technique has proved to be rapid and to give usable results comparable to in-hole shooting in many areas. The method is particularly attractive where portability is required since the weight of the mortar and its associated equipment is only 57 lb.

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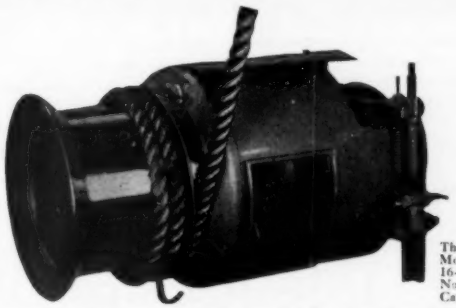

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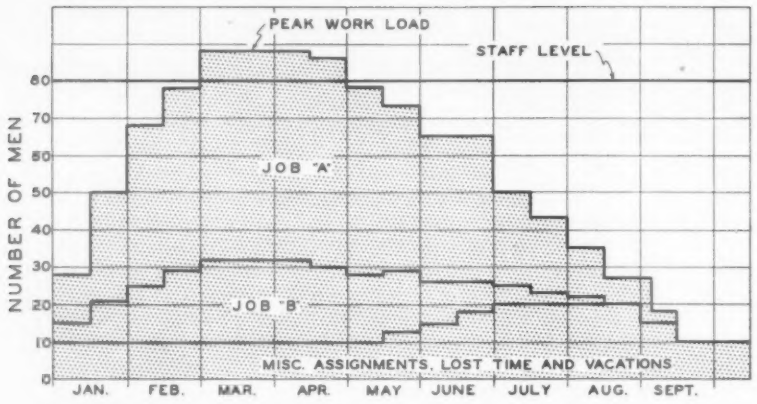

Fig. 1—Engineering manpower forecast and loading chart for two jobs running simultaneously.

BUILDING REFINERY PROCESS UNITS—2

. . . Scheduling the Engineering and Drafting

Since these factors must compete with other work for manpower and attention, their detailing is more important than it is for construction operations

by M. Mattozzi*

PROBABLY the most critical phase in the scheduling of a process refinery unit is the engineering and drafting, particularly where two or more jobs are being designed simultaneously. Since it takes a good deal of time to train a force to function as a team, it is no particular secret that maintaining a fairly constant level of technical personnel is a definite advantage. Planning, therefore, should be guided as far as practical by this principle.

*Arabian American Oil Co.

Manpower Loading Chart

How long a period will be required for the design phase on a particular job? The answer must be based on the following factors:

1. Manpower requirements under ideal conditions.
2. Availability of manpower generally within the department.

It should be noted that in accordance with the "ideal curve," presented in the first article of this series, the ratio established for the average force to actual force at the peak is 1.65. Therefore, in order to perform efficiently on a given contract, some "peaking" is unavoidable. However, circumstances may make it somewhat difficult to conform strictly to this "ideal" pattern and an analysis should be made of all work in the office to arrive at a realistic manpower application. This can be accomplished by means of an engineering forecast or manpower loading chart as per accompanying Fig. 1.

The loading chart should reveal:

1. Total work load in office.
2. Total and/or anticipated staff.
3. How much surplus manpower will be available at any given date.
4. Jobs running parallel.

In addition, if plotted far enough ahead, it will also serve to indicate the general employment trend.

Jobs running parallel . . . This condition should be avoided as far as possible due to the effect of loading specific design groups beyond their capacities. For example, should two or more projects arrive in the piping department simultaneously, it becomes a problem to stagger the work sufficiently without altering the final result. The situation of course will arise from time to time, but can be pretty well minimized if the total manpower require-

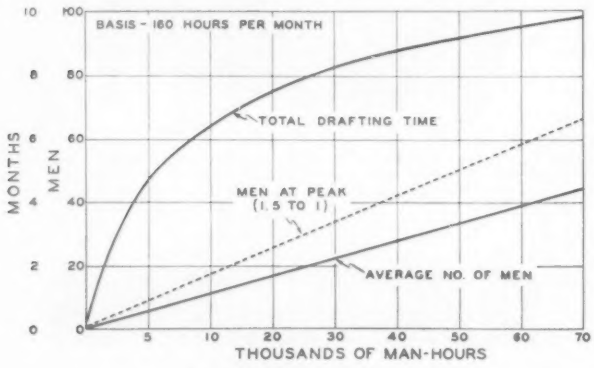

Fig. 2—Drafting schedule chart.

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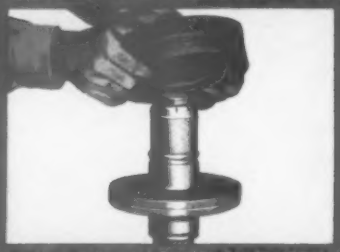

With the new Mission Rubbers installed, the piston is ready for another long run at a fraction of the cost of a new piston.

The secret to lower costs is right under your thumb . . . embossed on this page. Change the rubbers and save the piston! With Mission you reduce piston renewal costs three ways: (1) It's easier to replace piston rubbers because you don't have to remove the piston from the rod. (2) It's cheaper because you save the cost of the piston body. (3) Long-life rubbers make replacement less frequent. This means less down-time when Mission Pistons are used. Mission products are available in all supply stores. Specify "all-Mission."

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ments are staggered somewhat at the inception.

Ideal curve not too good . . . The task of preparing a forecast is fundamentally dependent upon the establishment of a time period for the engineering-drafting operation. Very little if anything has ever been published on this matter with the exception of the ideal curve which offers only partial assistance. All that the ideal curve tells us is the pace of the job **based on a predetermined time factor.** For example, a job theoretically could follow the curve whether it was planned for 3 months or 6 months. Consequently, this data is useless in predicting manpower usage unless the individual preparing the schedule can establish the length of the engineering program to begin with.

Drafting Schedule Chart

Fig. 2 is a chart which has been prepared to help solve this problem. The data contained therein represents the writer's experience in the actual scheduling of many contracts and has proven completely reliable in practice. This chart is somewhat on the conservative side but by far the greatest majority of jobs will fall in line with this pattern.

Since the proportion of engineering time to actual drafting varies considerably throughout the industry, the chart was based on pure drafting time which varies only slightly, and is therefore comparable to a construction manpower estimate of direct field labor.

To determine length of the engineering-drafting program a fairly reasonable figure representing the number of drafting man-hours is required. This may be available from the job estimate or can be calculated by estimating the quantity of various drawings to be prepared and then arriving at the hours required for each drawing in accordance with Table 1.

When drafting has been 100 per cent completed, engineering for all practical purposes should be finished very shortly thereafter. However, depending on the company organization and the duties assigned to the project engineer, he may not stop charging time to the job until it is "on stream."

When the time period has been obtained from Fig. 2, and the job pace developed with the assistance of the ideal curve, the (Fig. 1 of the preceding article) program can be plotted on a manpower loading chart including or excluding pure engineering hours as desired.

Based on averages . . . Incidentally, information in Table 1 not only permits calculation of drafting man-hours but

TABLE 1—DRAWING MAN-HOURS AND RATIOS

Type drawing—	Per cent of total drawings	Hours required per square foot: Unchecked drawing	Checked drawing	Total
Foundations	8	11.04	7.36	18.4
Structural steel	9	11.52	7.68	19.2
Vessels	10	6.15	6.15	12.3
Piping	46	19.26	23.54	42.8
Pipe supports	8	17.88	11.92	29.8
Electrical	8	9.70	9.70	19.4
Instrumentation	5	8.85	8.85	17.7
General (plot plan, etc.)	6	10.26	6.84	19.1
	100			*24.4
Buildings		†14.85	†14.85	†29.7

*Weighted average. †Add 10 per cent to total hours for material listing and requisitioning.

also discloses that a definite relationship exists percentagewise between the various phases of drafting and drawing progress. Please note, however, that the figures are **averages** obtained from the writer's experience covering many jobs. In the final analysis it is up to the scheduling engineer to calculate these percentages for each specific contract and the tabulation therefore is only intended as a guide. Building drawings have not been included in the scope, since this factor varies too greatly.

As mentioned previously, some organizations can profit from detailed scheduling while others cannot or are not set up to permit its effective execution. However, since engineering and drafting for a particular job usually must compete with other work in the office for manpower and a proper share of attention, it is felt that detailing of the drafting and engineering operations is considerably more important than it is for construction operations. Along this line of thought, we will explain the steps required to arrive at the dates shown in the schedule sheet, Fig. 1 of the preceding article.

Perhaps some of the explanations that follow may seem rather elementary. However, the writer has frequently been astonished to discover the lack of knowledge on the part of project engineers, some holding top positions, regarding the flow of data and work through a design group.

The schedule sheet, Fig. 1 of the preceding article, reflects the listing of certain "control items" described in that article, including two large columns with related equipment, piping, and electrical work. Since the design pace of most process refinery units is usually geared to piping (representing 42.8 per cent of total drafting time as per Table 1 of this article), the first problem is to get piping layouts under way.

For the key items listed in the schedule sheet, the piping section requires:

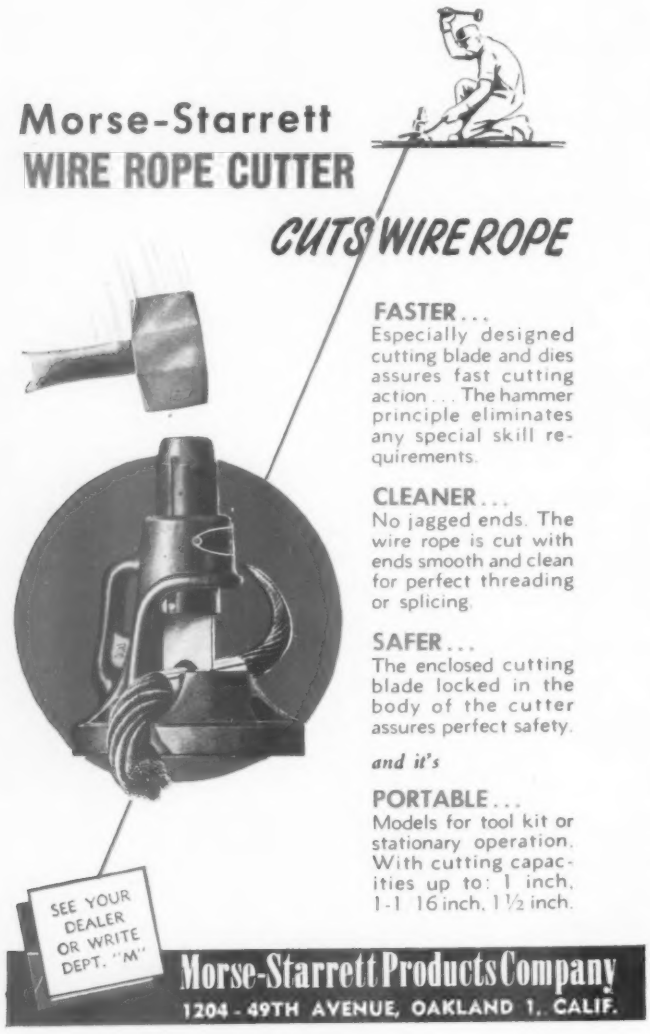
1. A sketch or layout of all vessels in the area.
2. At least preliminary vendor drawings of all equipment.

Vessel drawings . . . To obtain this information, it is necessary to prepare a sketch for each vessel. When this is completed, it is transmitted to the purchasing department with a material requisition, so that negotiation of bids can be started. The release of a **requisition** from a vessel group is scheduled on the basis of time required to prepare these vessel drawings as listed in Table 1. In scheduling the release of a requisition for these items, the preparation of a vessel sketch is involved as noted. Completion of this operation is represented by circled R symbol for Items 1, 3, and 7 in the schedule sheet, Fig. 1 of article 1. Note that Item 7 is required 2 weeks later than Items 1 and 3 since the columns are far more important and should take precedence.

Vendor drawings . . . For certain other equipment vendor drawings are required and these present a slightly different problem and are obtained from an outside source. Requisitions are written early for these items so that purchase can be completed and preliminary drawings started. The release of these requisitions is also indicated by the circled R symbol, the estimated purchase order placement by the circled O symbol, and receipt of the equipment drawings by the circled ED symbol.

Piping design . . . When the above data have been transmitted to the piping group, design can be started. The initial layout usually shows just the major lines, the remainder being added later. An estimate is made of the number of drawings and time involved and completion of this work is indicated by the circled L symbol.

The initial piping layout then releases further activity as follows: (1) design of the steel structures and (2)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orientation of vessel nozzles and checking of vessel drawings under the primary goal is a material requisition for the fabricated steel. Once the piping layout is issued unchecked drawings suitable for placement of order and reservation of major steel members can be prepared. This requisition for the fabricated steel is also represented by the circled R symbol for Item 5. In addition preliminary structure drawings release remainder of design work on foundations (since data on the vessels have been transmitted previously) and permit the start of electrical drafting.

Under (2) when the vessel drawings are checked, the fabricator can start preparation of shop details. These are submitted for approval and fabrication release granted, indicated by the circled FR symbol.

Equipment drawings can now be approved and/or comments made, as necessary.

Checking the drawings . . . The above actions having been accomplished, the structural steel drawings are checked and released for fabrication, and the foundations are checked against checked vessel drawings, checked steel drawings, and approved equipment drawings. This is followed by the checking of piping drawings and then electrical drawings.

The above description of the processes involved in scheduling work of this nature is provided to acquaint the reader with the kind of sequential thinking required for the preparation of an intelligent program. In actual practice, an intimate knowledge of design procedures is essential. The person scheduling engineering and drafting must be aware, for example, of what information is required to prepare a foundation drawing, the specific data it will be checked against, and such things as the relationship of underground sewer lines to foundations and underground power to underground piping. In short, he must familiarize himself thoroughly with every design function before he can prepare a genuine schedule. Meaningless symbols on paper not only destroy confidence in the scheduling operation but can cause so much confusion as to be looked upon as a handicap rather than a help.

More general method . . . For those organizations not equipped to work as precisely as described, a broader concept can be taken by merely scheduling the time period for engineering and drafting for each of the items in the schedule sheet by means of a bar or line extending from start to completion of design. This method, of course, allows a great deal more latitude and subsequent actual progress must be watched more carefully to avoid situations that might prove detrimental to the program. Again, this does not mean that the scheduling engineer is to draw lines haphazardly on a form. In spite of the fact that he may not indicate specific design operations, he must nevertheless visualize them in preparation.

Motor-Gasoline Survey, Summer 1952

by O. C. Blade*

MOTOR gasolines sold in the United States during the summer months of 1952 were higher in antiknock ratings than those of the preceding winter and those of the summer of 1951. Average octane numbers were close to the record octane numbers of motor fuels of the winter of 1950-51. The research octane number of premium-price gasolines even exceeded slightly the previous high figure. Comparative figures are given in Table 1.

TABLE 1—COMPARISON OF OCTANE NUMBERS, 1949 THROUGH 1952

	Octane numbers			
	Prem. price		Reg. price	
	Research	Motor	Research	Motor
Summer 1952	90.6	82.2	83.6	78.4
Winter 1951-52	90.0	82.0	83.1	78.1
Summer 1951	89.7	81.7	82.5	77.6
Winter 1950-51	90.3	82.5	83.7	78.8
Summer 1950	90.0	82.0	83.5	78.2
Winter 1949-50	89.0	81.2	82.4	77.1

*Associate petroleum chemist, Bureau of Mines, Bartlesville, Okla. Summary of U.S.B.M. R.I. 4963.

A total of 3,395 samples collected from service stations throughout the country were analyzed for this survey by company laboratories under a cooperative agreement between the Bureau of Mines and the American Petroleum Institute. The samples represent the products of 113 companies, large and small, which manufacture and supply motor gasoline.

The data, tabulated by groups according to 17 marketing areas (districts) into which the country is divided, are published by the Bureau of Mines in its Report of Investigations 4963.

Table 2 shows, by districts, the average octane numbers of regular-price and premium-price gasolines sold during the summer of 1952.

TABLE 2—AVERAGE OCTANE NUMBERS BY DISTRICTS

District—	Research		Motor	
	Premium	Regular	Premium	Regular
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2. Mid-Atlantic Coast: R. I., Conn., N. J., Del., Md., Va., central and southern N. Y., and eastern Pa.	91.8	86.7	82.7	80.7
3. Southeast: N. C., S. C., Ga., Fla., Ala., and eastern Tenn.	91.6	85.2	82.8	79.9
4. Appalachian: Ohio, W. Va., western Pa., eastern Ky., and a small portion of Md.	91.3	86.5	82.5	79.9
5. Michigan	91.6	86.1	83.4	79.8
6. North Illinois: Northern Ind., northern Ill., eastern Iowa, and Wis.	90.0	83.5	81.4	78.1
7. Central Mississippi: Western Ky., southern Ind., southern Ill., and eastern Mo.	90.0	83.7	82.1	78.9
8. Lower Mississippi: Miss., La., eastern and southern Ark., and western Tenn.	91.1	84.6	82.6	79.1
9. North Plains: Minn., N. D., and S. D.	89.4	82.8	82.0	77.9
10. Central Plains: Neb., central and western Iowa, northwestern Mo., and northern Kans.	89.7	82.5	81.4	77.7
11. South Plains: Southern Kans., southwestern Mo., western Ark., Okla. and northern Tex.	90.1	82.2	82.1	78.3
12. Southern Texas	90.1	84.1	83.8	81.2
13. South Mountain States: Southwestern Kans., Panhandle of Okla. and Tex., western Tex., N. M., Colo., Utah, Ariz., Nev., and eastern Calif.	88.8	80.0	81.4	76.3
14. North Mountain States: Wyo., Mont., Idaho, eastern Wash., and and eastern Ore.	89.5	81.7	80.2	75.9
15. Pacific Northwest: Western Wash., and western Ore.	90.8	81.7	82.0	76.5
16. Northern California	91.0	81.4	82.2	76.5
17. Southern California	90.4	81.2	82.0	76.5
National average	90.6	83.6	82.2	78.4

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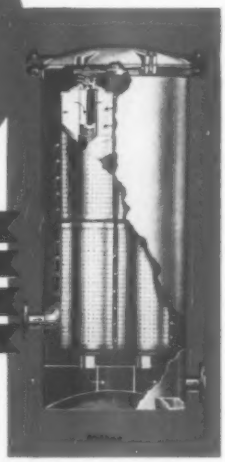

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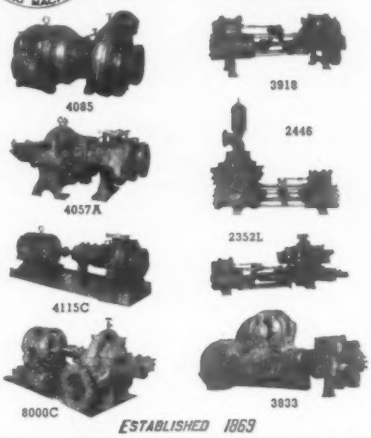

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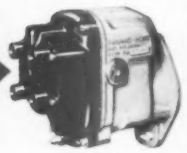

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SECTION

MAINTENANCE OF CENTRIFUGAL PUMPS—1

Design, Selection, Installation

by F. B. Applegate*

PREVENTIVE maintenance aims to minimize or eliminate the action of destructive forces before they cause damage. Nearly all of the destructive forces affecting the performance of centrifugal pumps are associated with: (1) erosion, (2) chemical action, (3) motion.

Pump Design and Materials

Important factors in pump operation are the design, the materials, and the workmanship entering into the construction of the pump. They are of major importance because they determine the structural strength and use life of each part. It is difficult to separate their individual contributions because of their dependence upon each other.

Design . . . Correct design form and proportions are necessary for smooth flow of liquid without excessive velocity and without turbulence. They permit parts to be fabricated from the material best suited to resist the action of corrosive liquids, extremes of temperature, or other service conditions. Because clean, smooth surfaces are more resistant to corrosive attack than rough, scaled surfaces, the design must make ample provision for cleaning and finishing liquid passages that cannot be machined.

Workmanship . . . This is important. Workmanship must be accurate because the centrifugal pump today is a precision-built machine. A half thousandth of an inch can be the difference between a free-running clearance or a destructive rubbing contact. A difference of less than a half thousandth of an inch can be the margin between a tight joint or something that begins as a pinpoint leak and ends as a destructive jet moving from a high to a low-pressure area. Surfaces of parts that cannot be machine finished must be thoroughly cleaned and finished smooth by hand filing, chipping, or grinding.

Dynamic balance should be included under workmanship. Because the destructive effects of unbalanced rotating parts increase in the ratio of the speed squared, dynamic balance is a must.

Good design, materials, and workmanship contribute to preventive maintenance by limiting chemical action in some degree and by eliminating erosion, unnecessary rubbing contacts, leakage, and vibration.

Pump Selection

The size and type are selected after a careful analysis and evaluation of the offerings of the various manufacturers. The materials of construction are generally specified by the purchaser on the basis of his experience.

Location of pump . . . This and the design of the piping are the responsibility of the plant design engineer. He must know the quantity of liquid to be pumped, its viscosity and vapor pressure at its pumping temperature, together with the required NPSH of the pump. These data are of paramount importance to him because they control the design details of the piping between the pump and its source of supply as well as the location of the pump relative to that source.

The most effective contribution to preventive maintenance will be made when a pump is properly selected, located, and piped. This will insure that the pump is full of liquid under all operating conditions, and eliminate destructive cavitation resulting from either a starved suction or the excessive release of vapor in the suction. The next best condition will exist if a poorly selected pump is properly located and piped. This pump will, in some degree, respond to preventive maintenance. The impossible condition will exist when a pump, regardless of how selected and piped, is improperly located in relation to its source of supply. No amount of maintenance, preventive or otherwise, will make this a successful installation.

Installation

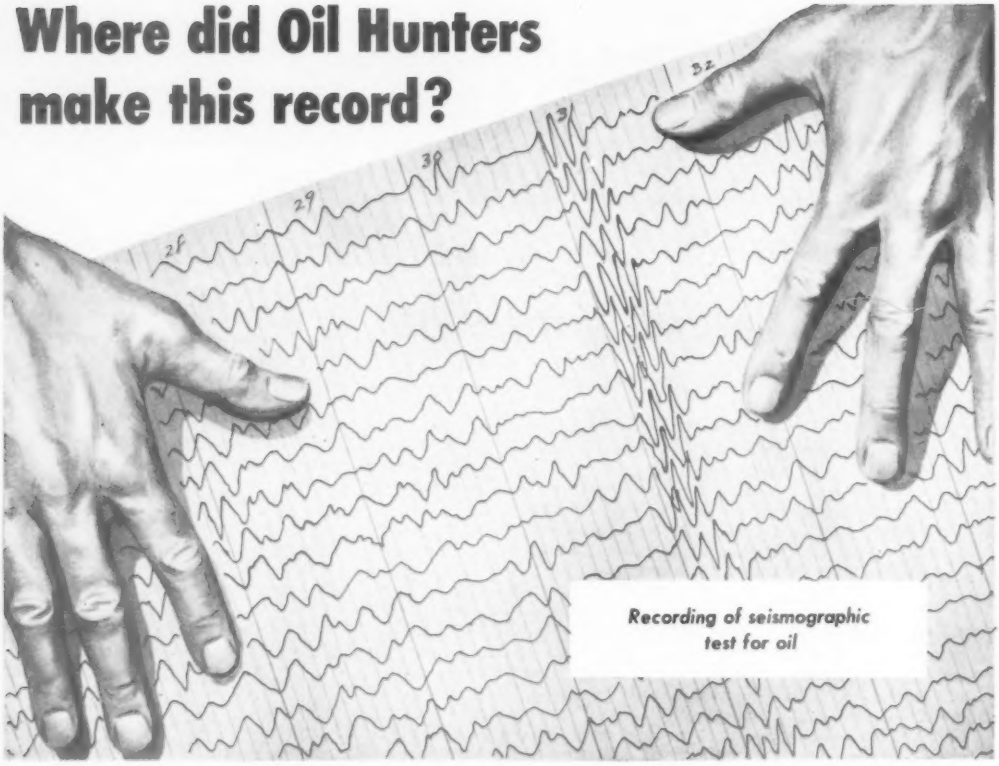
The installation engineer can contribute immeasurably to preventive maintenance. If the pump and driver are properly aligned, and the necessary precautions taken to insure its cleanliness during installation, his contribution will be toward trouble-free, low-cost operation.

Keep it clean . . . The necessity for accurate alignment of pump and driver is understood by everyone. The necessity for cleanliness is too often overlooked. Because the centrifugal pump is precision built, pipe scale, welding shot, or dirt of any description will cause serious damage in a very short time. Foreign materials may accelerate wear even in pumps specially designed for pumping liquid with abrasive material in suspension.

Make cleanliness during installation a must in your preventive-maintenance program. Do not remove protectors from pipe openings in the pump until the pipes are to be attached. Keep bearings and packing boxes clean; dirt will not prolong the useful life of bearings or packing and it is fatal to mechanical shaft seals. Either swab and flush the suction line before connecting it to the pump or install a temporary suction strainer at the pump.

*Engineer, Pacific Pumps, Inc. Paper presented at N.G.A.A. regional meeting, at Midland, Tex., February 27, 1953.

Where did Oil Hunters make this record?



Recording of seismographic test for oil

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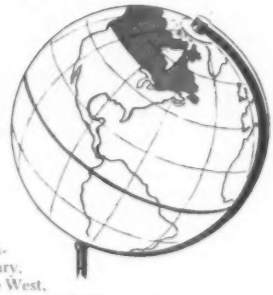

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While the Bank is prepared to provide all available information on the oil industry, it does not make recommendations regarding the purchase of individual oil stocks.

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HEATING-TUBE FAILURES—4

Failure From Mechanical Causes

by J. J. B. Rutherford*

CRACKS in the original material should be culled out. In an oil heating furnace, for example, especially fine inspection must be applied, since the hazard on failure is so high. A field weld is much more difficult to inspect, and this represents one of the major causes of failure. Fig. 1 shows some weld failures in Croloy 9 tubing, fusion welded with Type 310 rod (25 per cent chromium - 20 per cent nickel), after 15 months' service heating oil at 600-psi. pressure and 400° F. Fig. 2 is a photomicrograph to illustrate these cracks in the weld deposit metal, but which do not run into the base metal (shown etched).

It has been common practice to use an austenitic stainless rod around the refinery since this yielded a deposit of higher strength and better corrosion resistance than the surrounding material. The austenitic material is liable to have a dendritic, low-ductility structure, as in this case, or else be much stiffer than the base metal so that they part after cyclic heating as in Fig. 3. This is a Croloy 5 tube which was salvaged by welding with Type 310 rod, and then placed in service in a box type furnace, heating topped crude and heavy gas oil at 300 psi. and 850° F. Metal temperatures were estimated to be 1,200°-1,300° F. and on maintenance shutdown after less than a year in service, a leak was observed. On removing the tube, the weld fell apart.

Fig. 4 shows the position of the fracture which is in the base metal (shown etched) and not in the bead. On the basis of frequent failures of this type, where austenitic welding rod is used with ferritic materials, a welding rod of similar composition to the base metal, to afford a homogeneous weld, is recommended for service at elevated temperatures and especially when subjected to cyclic or fatigue loading.

* Babcock & Wilcox Co., tubular products division. From paper presented at John Zink Process heating seminar, Tulsa.

Fig. 3—Croloy 5 tube cracked adjoining Type 310 weld deposit.

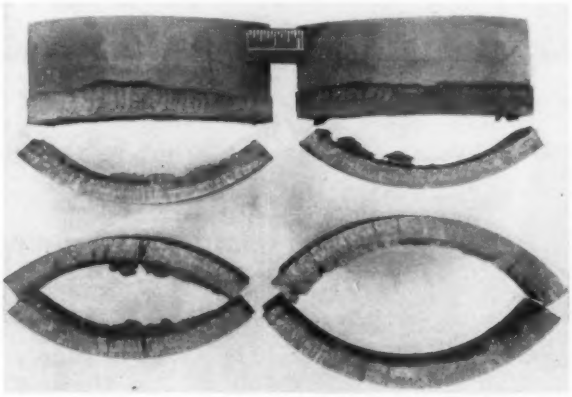

Fig. 1—Croloy 9 welded with Type 310 rod after 15 months service.

Fig. 2—Weld metal showing cracks and base metal (etched). Magnified —x100.

Fig. 4—Crack at weld interface. Magnified x250.

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Plans of long standing recently culminated in the moving of Wilson Supply Company, of Houston, into new quarters of sufficient size to house at one location the large and varied businesses of the company.

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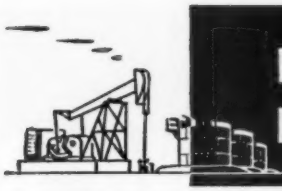

ENGINEERING FUNDAMENTALS

Production History of a Five-Spot Field

by Ralph F. Nielsen*

THE prediction of the production history of a property after initiation of secondary-recovery operations has been discussed at length in various publications. The viscosities of the oil and driving medium, effective permeabilities to the fluids, and initial saturations will largely determine the water-oil or gas-oil ratios as affected by time. If the formation consists of parallel beds of greatly varying permeabilities, with little intercommunication, the production history will also depend on the "permeability profile."

In certain favorable cases, where the oil viscosity is low, a bank of oil will form ahead of the water injected at the start of secondary-recovery operations. If we imagine a five-spot pattern in a layer of uniform permeability, the flood and its oil bank might appear like Fig. 1 during the early stages. The water-injection rate would follow the radial flow formula

$$Q = \frac{3.1\, K_w\, P\, h}{\mu_w \log (R/r)} \qquad (1)$$

where

Q = injection rate per well in bbl. per day
K_w = effective permeability in darcies to water behind the oil bank
P = bottom-hole injection pressure, psia.
h = thickness of the layer in feet
μ_w = water viscosity in cp.
r = well radius in feet
R = water penetration in feet

The pressure at the "front" is assumed negligible.

As the fronts from the input wells converge (Fig. 2) the input rates drop and finally level off (Fig. 3) at the rate expected from the five-spot formula assuming, of course, that the effective permeability to water remains constant. As the oil bank "cusps" into the producing well, most of the bank will be produced, after which the streak in question will produce water with some "trailing" oil production.

If the formation is composed of noncommunicating streaks of varying permeabilities, but having the same initial saturations and relative permeability relations, each streak will have a history given by Fig. 3, except for a proportionality factor on the rate and time scales. Furthermore, if the formation is considered divided into layers of equal thickness, each having a different permeability, the oil production from each streak may be roughly represented by a rectangle, as shown in Fig. 4. These rectangles are of equal area, but the height is proportional to the permeability, and the time required before the first oil production is inversely proportional to the permeability.

The total oil production at any time is then given by the sum of the heights of the rectangles at that value of the time. The calculation may be simplified by considering a smoothed permeability profile curve, and changing the abscissa scale of Fig. 4 so that a summation of the heights of the rectangles may be had by graphical integration. A sample calculation is deferred until the next installment of this series.

The figures obviously represent highly idealized conditions. No allowance is made for oil not banked or oil trapped in "dead" areas, and the entire geometry is oversimplified. However, these simplifications often "average out" over the complicated geometry and the heterogeneities actually existing, and calculations based on simple assumptions are generally in line with actual production histories.

*Associate professor, petroleum and natural-gas engineering, Pennsylvania State College.

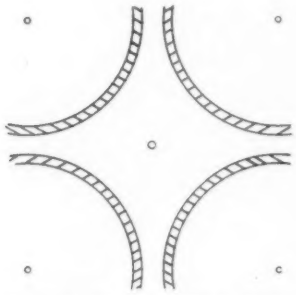

Fig. 1—Formation of oil bank in five-spot water flood.

Fig. 2—Collection of oil bank at producing well.

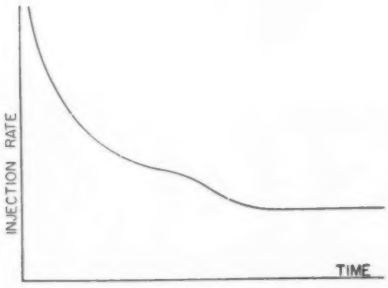

Fig. 3—Change of water-injection rate with time in newly imposed water flood.

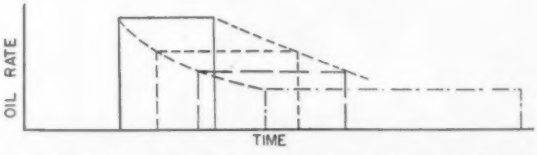

Fig. 4—Oil-production histories for streaks of equal thickness but different permeabilities.

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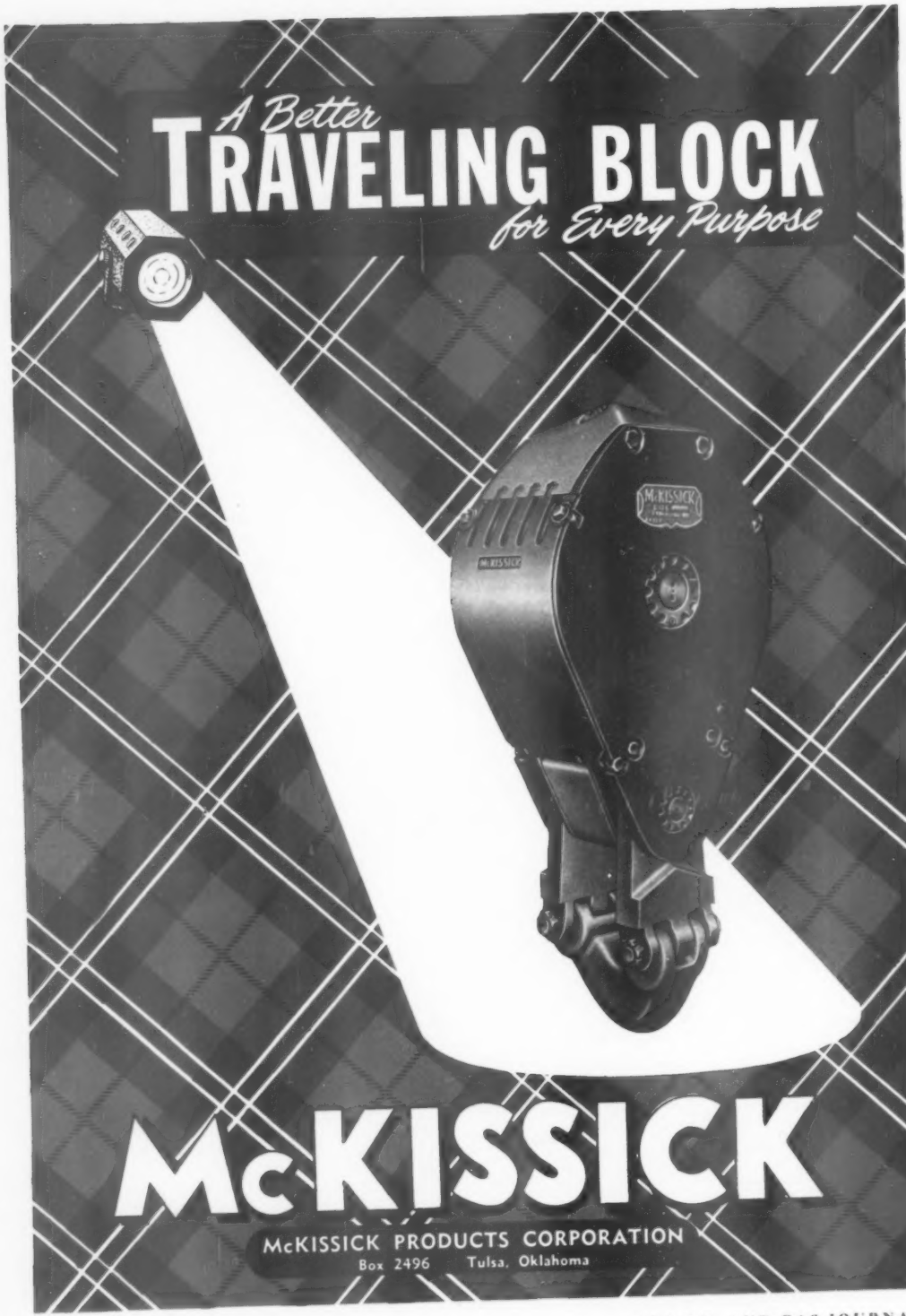
1. Yuster and Calhoun, The Producers Monthly, Nov. 1944.
2. Muskat, Physical Principles of Oil Production, McGraw-Hill, 1949.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Corrosion Case History

FOLLOWING 5 years of experimentation with various materials in a highly corrosive distillation operation, corrosion engineers have solved a particularly troublesome problem at Gulf Oil Corp.'s Philadelphia refinery.

The unit involved is a depropanizer tower operating in the refinery gas plant. The 30-tray tower, was placed in service in January 1946. The shell, fabricated from A-70 firebox-type carbon steel, was radiographed and stress relieved.

A 5/64-in. monel lining was installed in the top head; the bottom head and shell below the bottom tray were lined with ⅛-in. monel. Between the two monel-lined sections the shell interior was originally lined with a silicate-type acidproof mortar ¼-in. in thickness, which was applied to the parent wall. The internals consisted of meehanite bubble trays and caps.

The tower was designed for operation up to 250 psig., with a top temperature of 125° F., and a bottom temperature of 245° F. During its 5 years of operation, the vessel has operated at a maximum pressure of 245 psig., and average temperatures have ranged from 110° F. at the top to 240° F. at the bottom. Tower feed varied in volume and analysis with seasonal changes.

Sulfur content has gradually increased, along with the trend toward running greater proportions of sour crudes to stills at the Philadelphia refinery. The principal factor in this higher sulfur content is Kuwait crude which averages 2.55 per cent sulfur in contrast to other crudes, including Mara (western Venezuela) with 2.00 per cent sulfur, eastern Venezuela 0.90 per cent, south Louisiana 0.30 per cent, and coastal 0.23 per cent. On the average, the acid-gas content of the wet gas charged to the compressors has run about 1.2 per cent by volume. Feed rates ranged to a maximum of 120,000 cu. ft. per hour.

The wet refinery gas is compressed in two stages before depropanizing. The low-pressure and high-pressure accumulators behind the compressors are brick lined as is the reflux accumulator on the depropanizer. Some water and liquefied hydrocarbons are removed in the low-pressure accumulator. The high-pressure accumulator is operated for water removal alone, and liquid hydrocarbons are permitted to carry over to the depropanizer tower. Thus, water content of the tower feed is low, but the gas is rich in heavy ends, averaging 1.8 specific gravity with propane running 24 per cent and butanes plus averaging 60 per cent of total content. Oxygen content of the feed to the compressors is held below 0.20 per cent.

In April 1946, the tower was first opened for inspection. The shell lining in the top tray section was found to be in poor condition. The lining in this section, and at random points lower in the tower, was patched. Monel linings were found in good condition.

During the next three inspections, the mortar lining showed continued damage, and 50-60 per cent of the area required renewal each time. Tower intervals had to be removed for cleaning during each shutdown. Trays, bubble caps, and down pipes showed progressive signs of corrosive attack. Heavy deposits primarily of FeS formed by sulfur attack on the meehanite internals, required sandblasting for removal. Some tray section replacements were necessary during that period.

By July 1948, the mortar lining had completely spalled throughout the tower. Calibration of the shell showed a minimum thickness in the upper region of 0.720 in. versus the original 0.812 in.

The area between the two monel-lined ends was lined with an acid-resistant tile, laid with a vitrified cement bond in the conventional manner. The new lining was cured at 70°-80° F. for about 72 hours by placing steam coils in the tower manways.

Monel-lined nozzles in the tower had held up satisfactorily. The manways, not originally lined, were fitted with monel liners sealed on the inside by the tile lining. The tile job cost about $4,400, of which $1,200 went for materials, $2,500 for labor, and $700 was assigned to engineering, supervisory, and storehouse charges. New monel trays and bubble caps were installed throughout the tower.

When examined in July 1949, the tile lining was found to be in excellent shape, requiring no repair work. Deposits on the internals, which had given considerable trouble before, were found to consist mainly of sulfur, and were almost completely removed by flushing the tower with water. As a result, all trays were cleaned in place, requiring only partial removal for accessibility during inspection.

In June 1950, the loss of metal in the monel trays was pronounced and 40 bubble caps in the top six trays required replacement. At that time, engineers began testing new bubble caps, and five of inconel and six of Type 316 stainless steel were substituted in the top tray.

By December 1950, 100 bubble caps located in the top 17 trays needed replacement. These replacements were made with monel bubble caps. It was at this time that observations revealed that the Type 316 stainless-steel caps were withstanding corrosive attack better than the other materials.

In June 1951, further corrosion of internals was noted, and 100 bubble caps in the upper tower required replacement. At that time, some caps of Type 410 stainless steel were substituted for test purposes. Center sections of the top three trays also needed replacement.

The monel lining in the top head showed further attack, but was judged serviceable. Not so the bottom lining, which had deteriorated to a point requiring attention. A 2-in. lining of acid-resistant brick laid with a vitrified cement bond was applied to the shell and bottom head areas below the bottom tray. To date, after 3 years' service, the tile lining has proved an unqualified success. Although the monel lining did not hold up in the bottom section, top head has remained serviceable.

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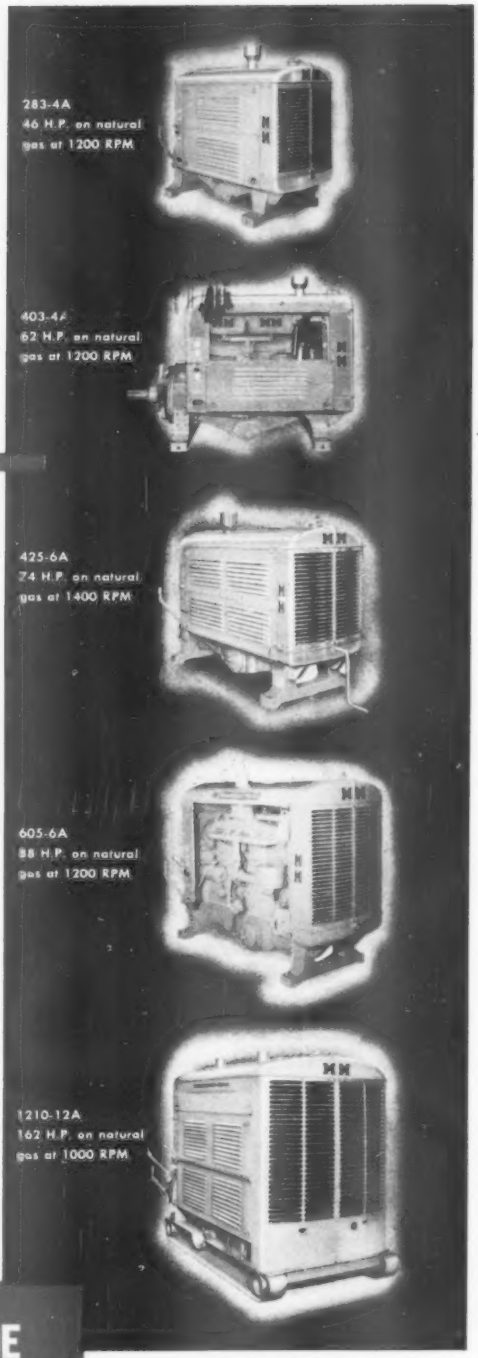
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by W. L. Nelson
Technical Editor

SHORT-TIME tensile strength tests even at elevated temperatures (above 700° F.) are not satisfactory for defining the strength of pipe-still tubes or their furnace supports. Stretching or creeping occurs causing distortion or early failure. Rupture may occur in 10,000 hours if the stress is larger than the creep stress for 10,000 hours by about 60 per cent (20-100 per cent), and similarly, during 100,000 hours if the rupture stress is about double the creep stress for 100,000 hours. Current A.S.T.M. specifications set maximum allowable stresses at temperatures above 900° F. that in most instances are about 50 per cent of the creep strength for 1 per cent deformation in 10,000 hours. A time of 10,000 hours is 1.14 years or 100,000 hours 11.4 years.

Strengths of higher alloy steels will be tabulated in the April 27 issue.

Creep Strength of Chromium and Chromium-Nickel Steels (To 9 Per Cent Chromium)

Material—	Approx. relative cost*	Chemical composition, per cent† Cr	Ni	Mo	C	Si	Mn	Psi. for 1 per cent creep in 10,000 hours or parenthesis in 100,000 hours, at 900° F.	1,000° F.	1,100° F.	1,200° F.	1,300° F.	Scaling temp. (°F.)
Low carbon steel	1.0				0.15	0.25 m	0.45	11,000	6,500	2,800			900-1,050
								(8,400)	(2,150)				
Carbon steel	1.0				0.3			(4,600)	(2,200)	(400)			950-1,050
Carbon moly	1.47			0.5	0.28			(9,350)	(3,600)	(450)			1,000-1,050
Carbon moly	1.47			0.5	0.15	0.25 m	0.6	22,000	12,000	3,000	1,500		1,000-1,050
Carbon moly				0.5	0.18	0.25	0.6	(14,000)	(5,000)	(1,500)	(400)		1,000-1,050
Carbon high moly				1.0	0.15	0.25 m		28,000	13,000				
Carbon high moly				1.0	0.15	0.15	0.45	(11,000)	(5,500)				950-1,050
Silicon moly	1.51			0.5	0.15 m	1.4			9,500				1,000-1,100
1 Chrome silicon moly	1.92	1-1.25		0.5	0.15	0.75-1.25	0.45	25,000	12,000	5,500	3,000		1,050-1,100
1 Chrome silicon moly		1.25		0.5	0.15 m	0.75	0.45	(14,500)	(8,500)	(3,000)	(1,200)		
2 Chrome moly		2.00		0.5	0.28	0.5 m		(16,000)	(7,100)	(1,350)			
2 Chrome moly	2.13	2.00		0.5	0.15 m	0.5 m	0.45	19,200	10,000	5,500	3,000		1,000-1,050
								(14,300)	(5,500)	(3,500)	(1,150)		
2 Chrome silicon moly	2.33	2.00		0.5	0.15 m	0.75 m			9,000		2,500		1,050
								(9,900)	(5,700)	(2,400)	(1,400)		
2 Chrome silicon moly	2.21	2.00		0.5	0.15 m	1.25	0.5 m	13,600	7,500	4,500	3,500		1,000-1,100
								(10,000)	(5,600)	(2,400)	(1,400)		
2 Chrome high moly	2.41	2.25		1.0	0.15 m	0.5 m	0.5	40,500	13,000	8,000	4,400		1,000-1,150
								(20,000)	(7,000)	(4,200)	(2,400)		
3 Chrome moly	2.6	3.00		1.0	0.15 m	0.5 m	0.45		11,000	7,200	4,000		1,050-1,100
									(6,800)	(4,500)	(1,500)		
3 Chrome silicon moly	2.54	3.00		0.5	0.15 m	1.25	0.5 m		8,500	5,000	3,500		1,100
									(5,400)	(2,500)	(1,800)		
5 Chrome moly	3.3	5.00		0.5	0.15	0.5 m	0.45	16,000	9,000	3,000	1,300		1,100-1,200
								(14,700)	(6,500)	(1,600)	(900)		
5 Chrome silicon moly	3.48	5.00		0.5	0.15 m	1.0	0.45		9,000	4,400	1,600	1,500	1,300-1,500
									(5,700)	(2,700)	(850)		1,300-1,500
5 Chrome silicon moly	3.53	5.00		1.0	0.15 m	0.75						1,800	1,250
5 Chrome silicon moly aluminum	3.6	5.00		0.5	0.15 m	0.75	(0.5 Al)		7,600			1,800	1,400-1,500
5 Chrome moly titanium	4.06	5.00		0.5	0.10 m	0.5 m	(0.4 Ti)		12,000			1,500	1,000
7 Chrome silicon moly	3.75	7.00		0.5	0.15 m	0.75	0.45	14,500	8,000	4,400	2,000		1,250-1,500
								(9,200)	(5,000)	(2,500)	(1,300)		
9 Chrome moly	5.5	9.00		1.5	0.12	0.5 m		(24,750)	(5,800)	(1,600)			1,400
									11,000				
9 Chrome silicon moly	5.5	9.00		1.0	0.15 m	1.0 m	0.45	33,000	12,000	7,000	2,300		1,300-1,500
								(25,000)	(8,500)	(4,000)	(1,600)		

*Relative to the cost of plain carbon steel. †The letter "m" means maximum allowable.

PROGRESS IN METALS

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Use and Care of Wire Rope—7*

. . . How to Apply Clips

THE length of rope to be allowed for the loop when attaching clips depends largely upon the number of clips to be used, which in turn depends upon the loads to be handled. This length will vary from 35 to 50 times the diameter of the rope; that is, for a 1-in. rope, at least 35 in. should be allowed for the short end, measuring from base of thimble. Allow approximately the length of clip base between each base.

Bind the top of the thimble with wire to the rope at the desired point. Then bend the rope around the thimble and secure temporarily by wiring the rope together as shown in Fig. 1.

Next apply the clip farthest from the thimble at about 4 in. from the short end of the rope and screw up tight. Be sure that the base or saddle of the clip rests upon the long or main rope and the U-bolt upon the short end, as shown in both Fig. 1 and Fig. 2. This applies to all clips put on. This saddle with the four prongs is designed to afford all the protection possible to the live end of the rope. If reversed, the U-bolts may damage the end carrying the load.

Also see that the short end of rope rests squarely upon the main rope.

The clip nearest to the thimble should next go on. Do not screw up tight when first put on. If one or more additional clips are to be used, place them equal distances apart between the clips already attached. Before tightening the clips put on after the first one, it is advisable to place some stress upon the rope to take up slack and equalize tension on both sides of rope. After this has been done, tighten up clips last applied.

After a rope has been in use a short while, all clips should be again tightened, as stress tends to stretch a rope, thereby reducing its diameter.

See that the nuts on each clip are tightened uniformly, by giving alternately a few turns to one side and then the other. It will be found that the application of a little oil to the threads will allow the nuts to be drawn tighter.

When a clip fastening is made it is necessary that the thimble used be of sufficient strength to withstand crushing. Use of galvanized drop forged clips is recommended.

*Taken from Bulletin 61, Use and Care of Wire Rope, A. Leschen & Sons Rope Co.

FIRST STEP in applying clips to wire rope. Fig. 1.

FINISHED JOB in clipping wire rope is shown here. Fig. 2.

TABLE I

Number of Drop Forged Clips Required to Make a Fastening Having Approximately 80 Per Cent Strength of High-Grade Wire Rope

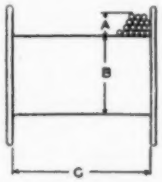
Diameter of rope in inches	Min. No. of clips required	Diameter of rope in inches	Min. No. of clips required
1/8	2	1 3/8	5
3/16	2	1 1/4	5
1/4	2	1 3/8	6
5/16	2	1 1/2	6
3/8	2	1 5/8	6
7/16	2	1 3/4	6
1/2	3	2	7
9/16	3	1 1/4	7
5/8	3	2 1/2	8
3/4	4	2 3/4	9
7/8	4	3	9
1	4		

Rope Capacity of a Drum or Reel

The length of rope that can be wound onto a drum or reel can be calculated very accurately if the rope is wound smoothly by using the following formula in which all drum dimensions are taken in inches:

$$\text{Length in feet} = A\,(A + B)\,C \text{ times "multiplier"}$$

A = depth of flange in inches
B = diameter of drum in inches
C = width between flanges in inches



MULTIPLIERS

Rope diam.:		Rope diam.:	
1/4-in.	4.16	1 1/4-in.	.167
5/16-in.	2.68	1 3/8-in.	.138
3/8-in.	1.86	1 1/2-in.	.116
7/16-in.	1.37	1 5/8-in.	.099
1/2-in.	1.05	1 3/4-in.	.085
9/16-in.	.828	1 7/8-in.	.074
5/8-in.	.672	2 -in.	.066
3/4-in.	.465	2 1/8-in.	.058
7/8-in.	.342	2 1/4-in.	.052
1 -in.	.262	2 3/8-in.	.046
1 1/8-in.	.207	2 1/2-in.	.042

Part 29 of a series

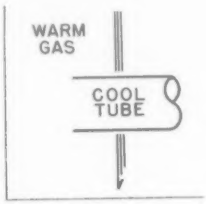
by Dr. B. E. Lauer, Head, Department of Chemical Engineering, University of Colorado

h_f HEAT TRANSFER

COEFFICIENT of HEAT TRANSFER through FILM between OUTSIDE SURFACE of a COOL TUBE and a WARM GAS

Tube Position: Horizontal

Gas Movement: Streamline Flow



EQUATION:

$$h_f = \frac{k}{D_o}\left[0.35 + 0.47\left[\frac{D_o V \rho}{\mu}\right]^{0.52}\right]\left[\frac{C_p \mu}{k}\right]^{0.3}$$

TERMINOLOGY:

h_f - Film coefficient of heat transfer, BTU/hr. sq. ft. ^{o}F.

k - Thermal conductivity of gas at t_f, BTU/hr. ft. ^{o}F.

D_o - Outside diameter of tube, ft.

V - Velocity of gas flowing past tube, ft./hr.

C_p - Specific heat of gas at constant pressure, BTU/lb. ^{o}F.

μ - Viscosity of gas at t_f, lbs./hr. ft.

t_f - Temperature of gas film, ^{o}F; $t_f = (t_s + t_g)/2$ where t_s is the temperature of the tube surface and t_g is the temperature of the ambient gas.

ρ - Density of gas at t_f, lbs./cu. ft.

LIMITATIONS:

Used to determine film coefficients for gases outside a single horizontal tube when the Reynolds number ($DV\rho/\mu$) of the flowing gas is between .1 and 1000.

SOURCES OF DATA:

For physical constants for use in above equation see Chemical Engineers' Handbook - J. H. Perry (1948).

for ρ -- see pp. 130-148, 175-195, 1583.
μ -- see pp. 370-374, 1198, 1696.
k -- see pp. 459-461, 1303, 1697.
C -- see pp. 225-235, 297, 1588, 1696.

REFERENCES:

1. Heat Transmission, W. H. McAdams, pp. 220.

2. Industrial Heat Transfer, Schack, Goldschmidt, and Partridge.

3. Chem. and Met. Engr., 51, H. J. Stoever (1944)

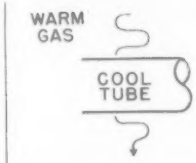
4. Applied Heat Transmission, H. J. Stoever, p. 59.

COEFFICIENT of HEAT TRANSFER through FILM between OUTSIDE SURFACE of a COOL TUBE and a WARM GAS

Tube Position: Horizontal

Gas Movement: Turbulent Flow

Direction of Movement: Normal to tube.



EQUATION:

$$h_f = 0.26\,\frac{k}{D_o}\left[\frac{DV\rho}{\mu}\right]^{0.6}\left[\frac{c\mu}{k}\right]^{0.3}$$

TERMINOLOGY:

h_f - Film coefficient of heat transfer, BTU/hr. sq. ft. ^{o}F.

k - Thermal conductivity of gas at t_f, BTU/hr. ft. ^{o}F.

D_o - Outside diameter of tube, ft.

D'_o - Outside diameter of tube, inches.

V - Velocity of gas flowing past tube, ft./hr.

μ - Viscosity of gas at t_f, lbs./hr. ft.

C - Specific heat of gas at constant pressure, BTU/lb. ^{o}F.

t_f - Temperature of gas film, ^{o}F, $t_f = (t_s + t_g)/2$ where t_s is the surface temperature of the tube and t_g is the temperature of the ambient gas.

ρ - Density of gas at t_f, lbs./cu. ft.

LIMITATIONS:

Equation gives results accurate to within ± 20%. Reynolds number ($DV\rho/\mu$) between 1000 and 50000.

SIMPLIFIED EQUATIONS:

For use with air or diatomic gases.

$$h_f = .24\,\frac{k}{D_o}\left(\frac{D_o V \rho}{\mu}\right)^{0.6} \quad \text{or} \quad h_f = \frac{.3\,C\,(V\rho)^{0.6}}{(D'_o)^{0.4}}$$

SOURCES OF DATA:

For physical constants for use in above equation see Chemical Engineers' Handbook - J. H. Perry (1948).

for ρ -- see pp. 130-148, 175-195, 1583.
μ -- see pp. 370-374, 1198, 1696.
k -- see pp. 459-461, 1303, 1697.
C -- see pp. 225-235, 297, 1588, 1696.

REFERENCES:

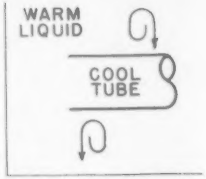
1. W. J. King, Mech. Eng., 54, 410 (1932).

2. Heat Transmission, W. H. McAdams, p. 222.

COEFFICIENT of HEAT TRANSFER through FILM between OUTSIDE SURFACE of a COOL TUBE and WARM LIQUID

Tube Position: Horizontal

Liquid Movement: Natural Convection.



EQUATIONS:

$$h_f = 0.53\,\frac{k}{D_o}\left[\frac{D_o^3 \rho^2 \beta g \Delta t}{\mu^2} \cdot \frac{c\mu}{k}\right]^{\frac{1}{4}}$$

For small cylinders - up to 1".

$$h_f = 0.47\,\frac{k}{D_o}\left[\frac{D_o^3 \rho^2 \beta g \Delta t}{\mu^2} \cdot \frac{c\mu}{k}\right]^{\frac{1}{4}}$$

For cylinders 1" to 6".

$$h_f = 0.11\,\frac{k}{D_o}\left[\frac{D_o^3 \rho^2 \beta c g \Delta t}{\mu k}\right]^{\frac{1}{3}}$$

For cylinders above 6".

TERMINOLOGY:

h_f - Film coefficient of heat transfer, BTU/hr. sq. ft. ^{o}F.

k - Thermal conductivity of liquid at t_f, BTU/hr. ft. ^{o}F./ft.

D_o - Outside diameter of tube, ft.

g - Acceleration due to gravity, 4.17×10^{8} ft./hr. hr.

c - Specific heat of liquid at constant pressure, BTU/lb. ^{o}F.

ρ - Density of liquid at t_f, lbs./cu. ft.

μ - Viscosity of liquid at t_f, lbs./hr. ft.

β - Coefficient of volumetric expansion. (cu.ft./cu.ft.)/^{o}F.

t_f - Temperature of liquid film, ^{o}F.; $t_f = (t_s + t_L)/2$ where t_s is surface temperature of tube and t_L is the temperature of the ambient liquid.

LIMITATIONS:

Cannot be used for forced convection. The term in the brackets must be greater than 1000.

SOURCES OF DATA:

For physical constants for use in above equations see Chemical Engineers' Handbook - J. H. Perry (1948).

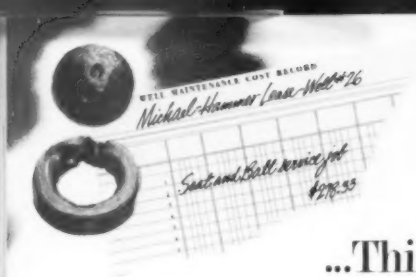
for μ-- see pp. 370-374, 1198, 1696.
β-- see pp. 200-202, 1875.
k-- see pp. 459-461, 1303, 1697.
C-- see pp. 225-235, 297, 1588, 1696.
ρ-- see pp. 130-148, 175-195, 1583.

REFERENCES:

1. Heat Transmission, 2nd Edition, pp. 241-245 (1942), William H. McAdams.

2. C. W. Rice, Trans. Am. Inst. Elec. Engrs., 42 (1923), p. 653-675.

3. Applied Heat Transmission, Herman J. Stoever, p. 59.



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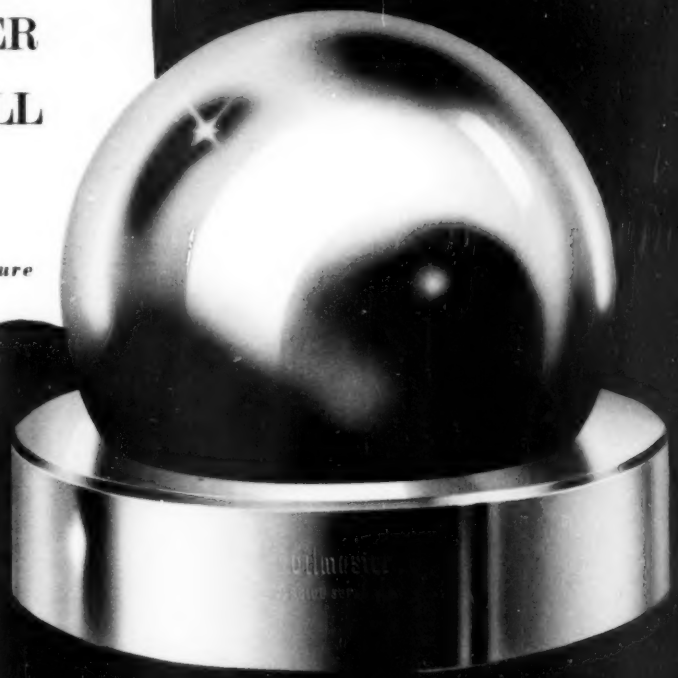

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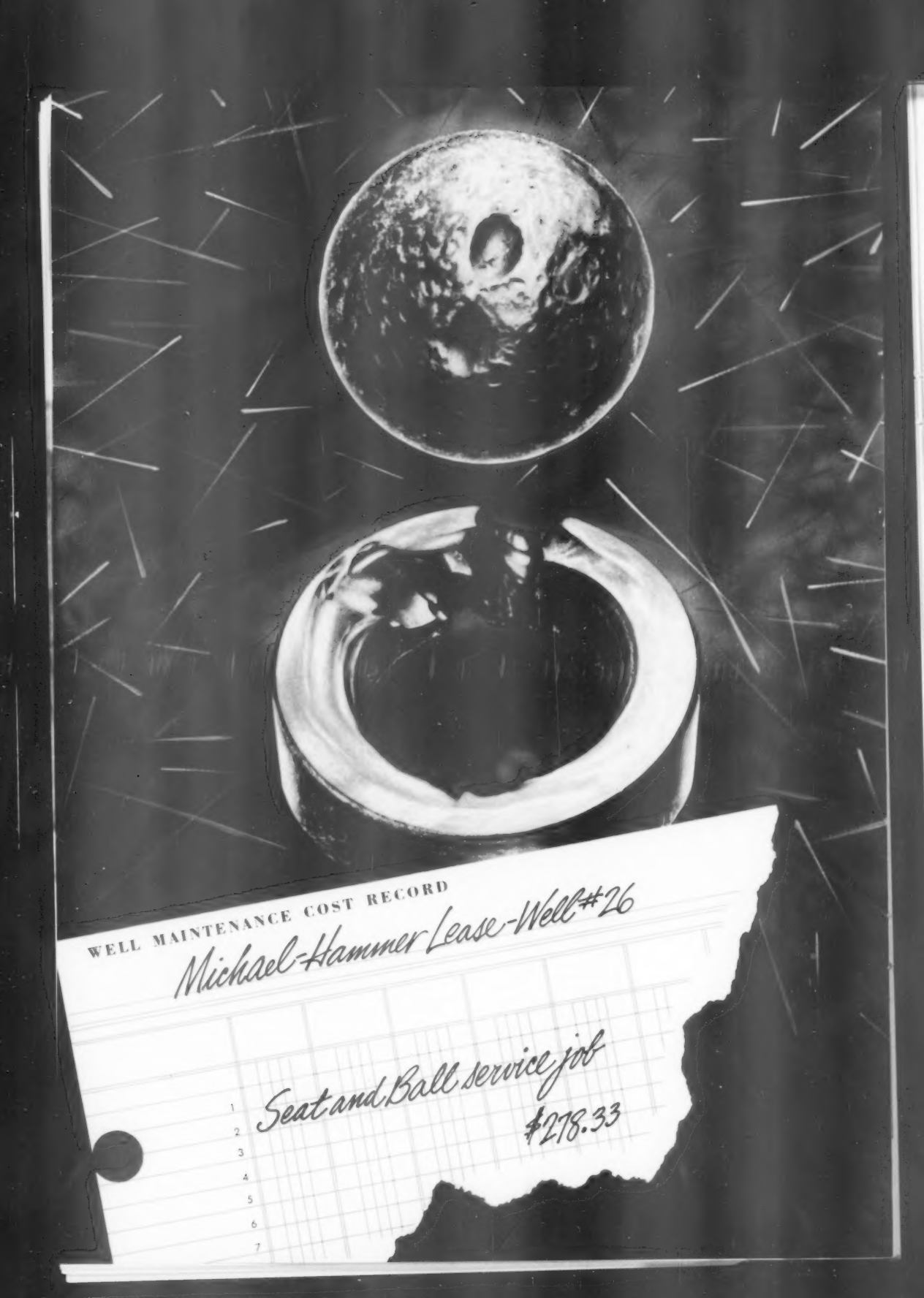
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EQUIPMENT MEN . . . in the News

Crawford Named Rocky Mountain Division Manager

R. O. CRAWFORD

Roland O. Crawford has been named Rocky Mountain division sales manager for Security Engineering Division, Dresser Operations, Inc., according to A. M. Birnie, general sales manager.

Crawford has been actively connected with the oil industry and with the sale of oil-field equipment since 1939. He first joined Security in 1946, and has worked in the Rocky Mountain, Illinois, California, and Texas areas prior to his recent promotion.

Blaw-Knox Names Rodgers General Sales Manager

W. RODGERS

William Rodgers has been named general sales manager of Blaw-Knox Co., effective April 1, it has been announced by W. Cordes Snyder, Jr., president.

In this new staff post Rodgers will coordinate sales activities for all divisions of the company, as well as assist in developing sales objectives, policies, and programs.

Rodgers formerly served with McCrady-Rodgers Co. of Pittsburgh as vice president and a director. In recent years he has been president of Moore-Flesher Hauling Co., Inc., and of Rodmor Hauling Co., both of Pittsburgh, and president of Lake Equipment Corp. of Erie, Pa.

Dowell Presents Service Awards at Annual Meeting

The annual meeting of Dowell Incorporated was recently held in Tulsa. Out-of-town directors who attended this meeting were Dr. L. I. Doan, president, The Dow Chemical Co.; Calvin A. Campbell, Dow; Dr. J. J. Grebe, consultant for Dow; N. D. Griswold, assistant general manager, Texas division, and Dow director, and Charles Penhaligen, Dow chief auditor. Dowell directors present from Tulsa were John G. Staudt, executive vice president; A. C. Polk, Jr., general manager; W. E. Reardon and W. J. Russell, assistant general managers.

A feature of this meeting was a dinner given by the company at the Tulsa Club where service awards were presented to 10, 15, and 20-year men.

Four Promotions Named By Magnet Cove Barium

New promotions at the Malvern mine and mill of Magnet Cove Barium Corp. have been announced by John Tobler, general superintendent. Elmer Coston has been named mill superintendent; Dan W. Martin, chief mine engineer; Richard J. Menze, chief metallurgist, and Joe L. Cheatham, metallurgist.

Coston was construction and maintenance foreman at the mill before his promotion. Before coming to Magcobar in 1944, he was employed by Talmaldy Co., of Niagara Falls, N. Y.

E. COSTON

D. W. MARTIN

Martin has been a mine engineer at Magcobar's Magnet Cove mine since January 1952. He is a graduate of Missouri School of Mines.

R. J. MENZE

J. L. CHEATHAM

Since August 1952 Menze has been serving as a metallurgist at the Malvern mill. Prior to that time he was a metallurgical engineer for Tennessee Copper Co., in Copperhill, Tenn.

Cheatham has been a laboratory assistant at the Malvern mill lab since 1950.

Folger, Chronister Named to New Posts by Orbit Valve

Charles J. Folger has been appointed Eastern representative, and Clyde Chronister has been transferred to the Gulf Coast division, according to R. G. Cole, general sales manager of Orbit Valve Co., Tulsa.

Folger will establish headquarters at Newark, Ohio. He is a chemical engineer, and a graduate of Case Institute at Cleveland. Previously he was associated with Owens-Corning Fiberglas Corp. in the technical development branch.

C. J. FOLGER

C. CHRONISTER

Chronister, who has served in the Eastern division for the past 4½ years and who has been with Orbit Valve since 1948, goes to the Houston office of the company. He will work out of the Gulf Coast division, which is under the supervision of L. E. (Ed) Wallace.

The company has also announced the opening of a new warehouse at Casper, Wyo. Jack H. Hancock, Rocky Mountain field representative for Orbit Valve, will be in charge. The new warehouse will serve the entire Rocky Mountain region as well as the western Canadian oil fields.

McLemore Establishes Consulting Service

Robert H. McLemore has announced his resignation from active management in Welex Jet Services in the position of executive vice president and general manager, effective April 15, 1953, in order to devote the major part of his time to consulting work in professional engineering. He will remain a member of the Welex board of directors and Welex executive committee.

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TEXAS PANHANDLE REPRESENTATIVE: Atlas Tank Co., Pampa, Texas.

group who organized Welex Jet Services in 1946, and developed the Jet Process for which the company has become noted. The success of Welex has been due largely to his professional knowledge and broad experience in the oil industry prior to the organization of the company. McLemore was associated with Sun Oil Co. as a petroleum engineer from the time of his graduation from Texas A. & M. College in 1933 until July 1951 when he went on active duty with the Army Air Forces.

Shackleford Speaker at Symposium Meeting, Chicago

R. E. Shackleford, general manager of Perrault Equipment Co. in Tulsa, was chosen by Society of Corrosion Engineers as spokesman for United States coating equipment manufacturers at a Pipe Line Coatings Symposium in Chicago March 17. Shackleford was on a panel of experts at a question-and-answer session during the 2-day meeting.

First American Iron shop at Tonkawa, Okla., 1923.

American Iron & Machine Observes Thirtieth Anniversary

This month the American Iron & Machine Works Co., Oklahoma City, manufacturer of oil-field tools, celebrated its thirtieth anniversary and in conjunction with their observance, the firm awarded to 128 employes, pins for 5 years or more of continuous service.

J. A. GRAY

Present officers of American Iron are: J. A. Gray, chairman of the board; M. G. McCool, president and general manager; E. E. Rubac, executive vice president; V. L. Thomas, secretary and treasurer; C. L. Griffin, sales manager; V. S. Harlin, chief engineer; and J. B. Sullivan, plant manager.

American Iron & Machine was organized in March 1923 by John F. Callioux and at that time its activities were mainly oil field repair work in a field near Tonkawa, Okla. An overshot and sucker-rod sockets were the only manufactured items. Late in 1926 American Iron moved from its location near Tonkawa to its present location in Oklahoma City. In the new plant the list of manufactured products grew. New items included wall hooks, milling shoes, paraffin bits, tapered taps, tool houses, steam lubricators, and rock-bit breakout blocks. During the period from 1926 to 1944 the growing firm established oil-field repair shops in various localities in Texas, Oklahoma, Kansas, Illinois, and Louisiana and an additional manufacturing plant at Houston. In 1944, because the management decided to concentrate its efforts in the manufacturing field, most repair facilities were sold.

M. G. McCOOL

E. E. RUBAC

In 1946, J. A. Gray and associates acquired controlling interest in American Iron and M. G. McCool became vice president and sales manager. In 1949 Gray was elected chairman of the board and the present officers were installed. By 1947 additional manufactured items included slush-pump valves and seats, drill collars, kellies, catheads, fishing tools, packers, and the firm began manufacturing a complete line of rotary-tool joints including the Amweld, Flashwelded, and the hand-applied Straight Grip.

The manufacture of rotary-tool joints necessitated an expansion program of about 2½ million dollars which has just been completed with the installation of the second continuous-type atmosphere-controlled furnace and a new electric flash welder. All this expansion made it necessary to provide facilities for the storage and stocking of drill pipe. The firm's No. 2 plant on High Street, covering over 20 acres, can accommodate a million feet of drill pipe.

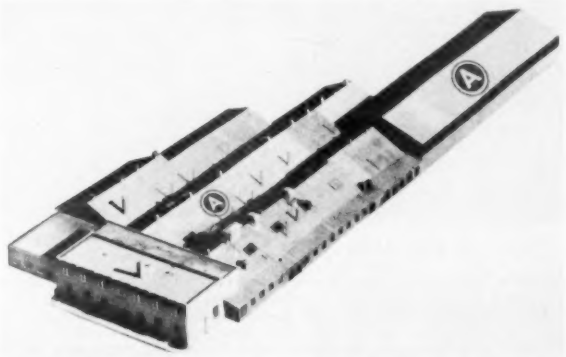
American Iron now employs 425 people.

V. L. THOMAS

C. L. GRIFFIN

V. S. HARLIN

J. B. SULLIVAN



Present American Iron shop and offices in Oklahoma City.

Fishing Tool Co. Opens Branch at San Angelo, Tex.

The Fishing Tool Co., Inc., of Odessa, Tex., has announced the opening of a branch at San Angelo, Tex. Ross Jones and Ross Ray will handle San Angelo sales and service for D & J reverse-circulation cone and junk baskets, and the complete line of Bowen of Texas oil tools.

(Continued on page 246)

CLEANER PIPELINES CO.
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INTERNAL PIPELINE CLEANING EQUIPMENT:

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PIPE LINES

T.G.T. Program

1953 projects include 369 miles of natural-gas lines

HOUSTON. — Tennessee Gas Transmission Co.'s 1953 construction program is designed to enlarge the company's natural-gas pipe-line system, Charles S. Coates, senior vice president, announced.

The program includes laying of about 369 miles of pipe line in Texas, Louisiana, Tennessee, Kentucky, and Pennsylvania; enlarging two of its existing compressor stations; and completing construction of a new twenty-sixth station.

The 369 miles include 237 miles of loops to be built parallel to sections of the existing system, and a new 132-mile, 26-in. line to begin at the company's compressor station near Mercer, Pa., and extend northeast to Hebron field in Potter County, Pa., where construction of storage facilities has been authorized by the Federal Power Commission.

W. C. McGee, Jr., vice president and general superintendent of operations, said construction of the first two sections of loop pipe line began in late January and February in south Texas.

Other details of the construction program were given by E. S. Murray, company chief engineer, as follows:

... **Texas:** Three sections of loop pipe line will be laid in the state. A 43-mile 26-in. length of line from near Edinburg to near Falfurrias, and a 23-mile section of 30-in. line from near Sinton to near Refugio, are both under construction. Another section of 30-in. pipe line about 28 miles long will be laid from near Edna to about 10 miles southeast of East Bernard.

... **Louisiana:** A 22-mile, 30-in. section of line to be laid parallel to the system from near Natchitoches to near Goldonna. Completion of a new compressor station near Kinder, where installation of five engines with 1,320 hp. each, for a total of 6,600 hp., is in an advanced stage.

... **Tennessee:** An 18-mile, 30-in. stretch of loop line will be laid from south of Bolivar to near Selmer, and a 47-mile, 30-in. line from a point about 20 miles north of Nashville to near Bowling Green.

... **Kentucky:** A 35-mile, 30-in. line from near Campbellsville to near Danville, and a 21-mile, 26-in. line from near Carter to the Ohio River.

... **Ohio:** Two 1,320-hp. compressor

Plow Takes Up Pipe Line

R. B. Potashnick, pipe-line contractor of Cape Girardeau, Mo., installed special equipment on a large tractor to facilitate operations for taking up pipe for Texas-Empire Pipe Line Co. in Illinois. This equipment consists of a plow pushed by the tractor on which it is mounted. It is pulled by a cable towed by another tractor ahead. At the front end of the plow are two bars which protrude so that they follow along the pipe. By use of this equipment the dirt over the pipe was readily broken up to prepare for the removal of the pipe by equipment following along behind.

engines will be installed at Station 214 near Carrollton.

. . . **Pennsylvania:** A 132-mile, 24-in. pipe line will be laid from near Mercer to Hebron field, Potter County, and two 1,100-hp. compressor engines will be installed at Station 219 near Mercer.

Contracts Are Let for Wilcox Trend Pipe Line

DALLAS.—Wilcox Trend Gathering System, Inc., has awarded H. B. Zachry Co., San Antonio, a contract for construction of 116.8 miles of 14 and 16-in. pipe line. The system will extend from Duval County to DeWitt County, Tex., and the crossing of the Guadalupe River.

A contract for construction of approximately 85 miles of laterals and gathering lines has been awarded to Altgelt Construction Co., Inc., Corpus Christi. Brown & Root, Inc., Houston, will build a 2,200-hp. compressor station near Thomaston, Tex.

Construction is scheduled for completion this summer.

Texas Eastern Contracts on Three Construction Projects

SHREVEPORT.—Contracts for three pipe-line-construction jobs and four river crossings have been let by Texas Eastern Transmission Corp., according to Baxter D. Goodrich, vice president and chief engineer. Pipe-line jobs are:

1. Associated Pipe Line Contractors, Inc., Houston, to construct 75 miles of 24-in. pipe line from Lavaca County to Waller County, Texas.

2. Williams Brothers Co., Tulsa, to construct 71.4 miles of 24-in. pipe line from Polk County to Shelby County, Texas; construction of Neches and Angelina river crossings; and construction of Attoyac Bayou crossing.

3. Anderson Brothers Co., Houston, to construct 82 miles of 24-in. pipe line from Waller County to Polk County, Texas.

Pentzien Inc., Omaha, Neb., was awarded contract to handle river crossings for the Trinity, Brazos, Colorado, and Sabine rivers.

Price to Lay 74 Miles Of 24-In. for T.G.T.

BARTLESVILLE, Okla.—H. C. Price Co. has announced it will build 74 miles of 24-in. high-pressure gas pipe line in northeastern Pennsylvania for Tennessee Gas Transmission Co., Houston.

The line will form the main portion of an extension to Tennessee's newly developed underground-storage facilities near Cowdersport, Pa. It will ex-

RIGHT on the line!

—This time RIGHT on the PLATTE—

—Where all 4 Contractors* used CLEVELANDS to cut 988 of the 1058 total job miles . . .

From the mud of the river bottoms in Missouri and Kansas through the dust and heat of Nebraska, into the rock, frost and hills of Wyoming, CLEVELAND dependability, versatility, economy and all-around "digability" again paid off.

In 1953, be sure you, too, use this finer trenching equipment which was RIGHT on the Platte.

Contractors for the Platte Pipeline:

R. H. Fulton & Co.

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Rumsey Bros. Pipe Line Construction Company

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tend northeasterly from a point near Mercer.

Right-of-way work already is under way and the pipe gang is expected to start work between April 15 and May 1.

Engineering Construction Co. Headed by Lee Vaughn

ENGINEERING CONSTRUCTION CO. is headed by Lee Vaughn, president. Other officers are Curt Vaughn, vice president and superintendent; and H. H. Griffin, vice president and secretary-treasurer; and J. E. Baker, assistant secretary and office manager. Headquarters office is located at 402 North Cheyenne Avenue, Tulsa.

LEE VAUGHN

The company is entirely owned by two stockholders: Vaughn and White Eagle Oil Co., which is headed by Walter Helmerich, II, president. Other officers of White Eagle Oil Co. are Walter Helmerich, III, vice president; and H. H. Griffin, vice president and secretary-treasurer.

Engineering Construction Co. has recently received a contract from Oklahoma Natural Gas Co. for a 50-mile, 18-in. line from Sapulpa to Choteau, Okla., and an 11-mile 20 and 24-in. line southwest of Oklahoma City. Coating operations have been subcontracted to Tulsa Pipe Coating Co.

During the last year and a half, Engineering Construction Co. has laid approximately 700 miles of lines ranging from 4-in. to 26-in. for Colorado Interstate Gas Co., Kansas-Nebraska Natural Gas Co., and Cities Service Gas Co. in Kansas, Nebraska, and Colorado.

The organization was engaged mainly in laying distribution and lateral lines in Tennessee and other southern states within the last 2½ years.

The contractor now has equipment for two main-line spreads and a gang for city work. It is licensed to operate in all states requiring contractors' licensing and is prepared to undertake construction for pipe lines of all diameters for petroleum and natural-gas service.

CROSE

PIPE CUTTING & BEVELING MACHINE

Gives you consistently uniform cuts under toughest field conditions. Unsurpassed in efficiency and economy. Full Circle Traveling Ring eliminates jerky movement. Insures cuts so smooth that buffing costs are negligible. Machines accommodating up to 14" pipe are equipped with standard type torch holder. Machines accommodating 16" pipe and larger are equipped with out-of-round attachment that allows the cutting flame of the torch to follow the surface contour of the pipe.

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PRICE PIPELINE PORTRAITS

R. L. "BOB" EZELL, Superintendent, Spread 2

Typical of the experienced pipeliners that command H. C. Price Co.'s construction operations is Bob Ezell, a veteran of twenty-three years with the company. After serving as a welding foreman for a number of years, Ezell was promoted to the position of spread superintendent in 1952-providing HCPCO with a qualified and highly-regarded pipeliner for this important assignment. Recently honored for leading his gang to an outstanding safety record, Bob has earned the respect and admiration of every pipeliner with whom he has worked. H. C. Price Co. is proud of its construction crews and their leaders . . . they assure the quality of workmanship and dependability that have made HCPCO "America's Foremost Pipeline Constructors."

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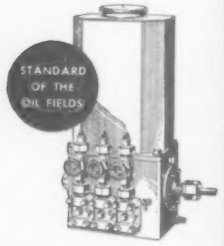
FOR SLUSH PUMPS AND DRILLING ENGINES

TYPE "SP" Mechanical Lubricators



Built to take it—to stand up under the extreme conditions of oil field service on slush pumps and drilling engines. You can depend on McCord "SP" lubricators to deliver oil in measured quantities without interruption regardless of temperatures. Removable pump units, large clear blinker sight feeds. All moving parts enclosed. Specify McCord "SP".

McCORD CORPORATION
DETROIT 11, MICHIGAN

REFINING

Old Dutch Sets New Record On Platformer Catalyst Life

MUSKEGON, Mich.—A recent run by Old Dutch Refining Co. of Muskegon, established a new record for Platforming catalyst life, of 110 bbl. of charge per pound of catalyst.

The former record for the company's unit was 92½ bbl. per pound. This first commercial Platforming unit, completed in October 1949, has been expanded from the original 1,500 bbl. per day to 2,500 bbl. per day.

New Esso Units at Everett Will Go On Stream June 1

EVERETT, Mass.—A new 18,500-bbl. per day fluid catalytic cracking unit will be placed in initial operation about June 1 at Esso Standard Oil Co.'s refinery here. At the same time other new facilities will go on stream, increasing the plant's crude capacity from 32,500 to 38,500 bbl. per day.

Foster Wheeler Corp. held the contract for the modernization project which also included a fractionator, a gas-compression plant, and light-ends recovery facilities. A 7,000 bbl. per day rerun unit was built by local forces.

The new fluid unit replaces a 15,000 bbl. per day combination thermal cracking unit, and is the first catalytic cracking unit in New England. Following a general 6-week turnaround of all facilities excepting the asphalt plant, the modernized refinery will resume production of premium-grade gasoline which it has been unable to make since 1950.

Synthetic Detergents Are Taking Over Soap Market

NEW YORK.—Synthetic detergents, based primarily on petrochemicals, are making rapid gains in the cleaning field, at the expense of soap.

A survey of most domestic manufacturers recently made by American Soap and Glycerine Association shows that total soap and detergent sales in 1952 reached 3.40 billion pounds compared with 3.31 billion pounds in 1951. Of this total synthetic detergents amounted to 1.53 billion pounds last

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WITH
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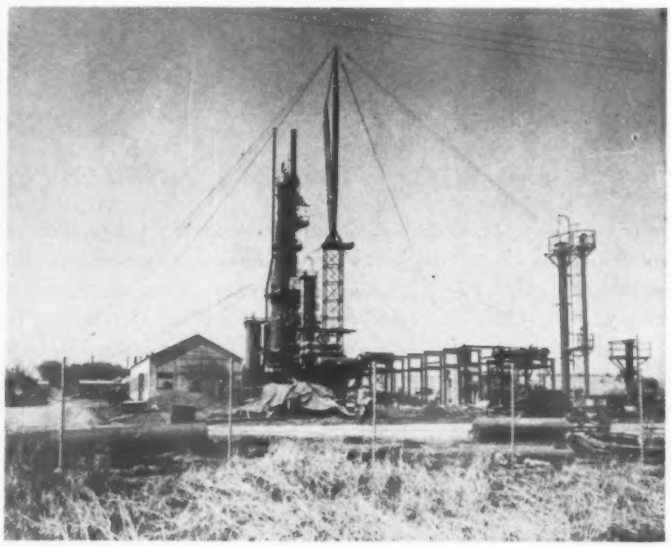

Co-Op Cracker Work Progressing

Construction work is about half complete on a new fluid catalytic cracking unit at the Cushing, Okla., refinery of Midland Cooperative Wholesale. The unit has a design rating of 5,000 bbl. daily. Presently, the refinery has a crude-oil-charge capacity of 6,500 bbl. daily. Other facilities include visbreaking, 5,000 bbl. daily; and polymerization. R. G. Bandy is refinery manager; T. B. Randal is superintendent; and P. G. Maranville is assistant superintendent. Headquarters for the Midland Co-Op are in Minneapolis.

year compared with 1.26 billion pounds for the previous year.

Soap sales declined further, from 2.06 to 1.87 billion pounds.

Flasher Contract Let

EL SEGUNDO, Calif. — Standard Oil Co. of California has contracted with M. W. Kellogg Co. to build a 55,000 bbl. per day vacuum flasher at the El Segundo refinery.

This unit will be a duplicate of the world's largest vacuum which Kellogg designed and built at the company's Richmond, Calif., refinery 2 years ago. Construction is scheduled to begin by July.

Mass Measurement Possible With New Flow Meter

NEW YORK.—A flow meter that measures mass—and nothing but mass—was introduced recently at the American Research & Development Corp. show in Boston. The instrument was developed by Control Engineering Corp. of Norwood, Mass., which demonstrated its ability to record the mass flow of diverse substances such as air, smoke, dust, oil, and flowing particles of solids.

In practical use, it eliminates the mathematical work in converting volume measurement to mass measurement, and is capable of recording marked variations in mass flow.

Some custom-built models are now being installed but the instrument is not yet available in standardized form.

San Jacinto Chemical, Smith-Douglass Plan Merger

HOUSTON.—San Jacinto Chemical Corp. of Houston and Smith-Douglass Co., Inc., are negotiating for a proposed merger under the latter company name. San Jacinto operates a government-built synthetic anhydrous ammonia plant near here, with a capacity for producing 17,500 tons of net nitrogen per year.

Smith-Douglass, manufacturers and distributors of chemical fertilizers, will obtain a basic source of ammonia synthesized from natural gas, if the merger takes place.

Refining Briefs

LOS ANGELES. — General Petroleum Corp. in April will start construction on its $35,000,000 refinery, near Ferndale, Wash., on Puget Sound. The plant will operate on Canadian crude brought to the plant site through a 30-mile branch line of the 711-mile Edmonton-Vancouver line. Of 35,000-bbl. daily capacity, it is to be constructed by Bechtel Corp. and is scheduled to be completed in late 1954.

Trioxane, a crystalline form of formaldehyde, is now available from the Bishop, Tex., plant of Celanese Corp. of America. Now used by the military as the standard U. S. Army heating tablet for field rations, the new petrochemical has other uses as a component of air deodorizers, tanning agents, thermosetting resins, and electroplating baths.

Night and day the clock around, week after week, month after month, NATIONAL AIROIL Tandem Combustion Units ceaselessly assure *"continuous operation"* for petroleum heaters in refineries throughout the Nation and the world. YOU will realize higher profits from YOUR oil heaters when Tandem Combustion Units are specified.
NATIONAL AIROIL has a complete line of Oil and Gas Burners and Furnace Equipment for every requirement.

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Banff Oil Ltd.

announces the election of

- **WALTON H. HOHAG, Jr.**

as Vice President, Director and General Manager effective March 17, 1953

- Mr. Hohag, Jr. until recently was a Director, Vice President and Manager of Exploration of Socony-Vacuum Exploration Company

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For more information write for Bulletin No. 24.

THE INFERNO CO.
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SHREVEPORT, LA.

Among the Drilling Contractors

Penrod Rotaries Running On Three More Wildcats

Penrod Drilling Co., Shreveport, one of the most active contractors in Louisiana, has three new wildcat operations under way in the northern and eastern part of the state.

One, a Pettit lime test, located 2¾ miles northwest of Colquitt, Claiborne Parish, is under contract for W. O. Woodward, trustee. It is projected to 5,200 ft. Location, 1 Bailey, in 17-23n-6w, is 1½ miles southeast of the East Haynesville field.

Another, to be drilled for the W. C. Feazel interests and Southwest Gas Producing Co., at 1 Dye, in 16-19n-4w, 4¾ miles southwest of the Hico-Knowles field, in Lincoln Parish, is projected to the McFearin zone of the latter field around 9,000 ft.

The third is another Wilcox exploratory test to be drilled for H. L. Hunt in Catahoula Parish. Location is for 1 International, in 27-10n-6e, 3 miles northwest of Harrisburg. Its objective is expected around 5,300 ft.

Lester Rice & Sons Drilling Co. has the contract for Charles C. Green, Jr., and Oceanic Oil Co. 1 Sue Alice Slaughter, wildcat test 2 miles northwest of production in the Vealmoor field of Borden County, West Texas. Location is in 24-33-T3N-T&P Survey.

Tulsa Producing Firm Forms Drilling Affiliate

Beach & Talbot, independent producing firm with headquarters at Tulsa, has announced the recent formation of a drilling contracting affiliate under the name of Cimarron Drilling Co. Associated in the new drilling company with Robert Beach and J. A. Talbot, partners in the producing firm, is Lester F. Danford, who has been named vice president and general manager. Danford has had extensive experience in oil field work, previously having been associated with Pure Oil Co., Deep Rock Oil Corp., Dowell Incorporated, and Halliburton Oil Well Cementing Co.

Crescent Drilling Co., Monroe, La., has contracted with Monia Gas Co. and W. C. Feazel and associates for another Cotton Valley test to be drilled in the Swartz area of Ouachita Parish, northeastern Louisiana. The new test, 1 Anderson, projected to the Cotton Valley Bodcaw zone, expected around 8,500 ft., is 1½ miles southeast of the Swartz townsite and about a mile south

On the rig floor of the twenty-fifth well drilled by Commercial Petroleum & Transport Co. of Houston in the North Cedar Bayou field, in Harris County, Texas Gulf Coast. Standing, left to right: Ben Young, chief engineer, Mission Manufacturing Co., Houston; J. G. Edwards, drilling superintendent; Harry Bryant, general superintendent; C. E. Richmond and Leonard Dickerson, drilling-crew members; T. F. Enloe, driller; William Underwood, Mission Manufacturing Co. Kneeling: C. T. Street (left) and J. B. Johnson, crew members. (Picture by courtesy Mission Manufacturing Co.)

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H.C.SMITH *has it*

H. C. Smith builds these cross-section bits in sizes down to 3⅛" as standard, stock items — not as "special order" or "custom" jobs which you have to wait for. You can get 'em *now*. And even in the smallest sizes, these bits feature the strong H. C. Smith construction — solid, one-piece pin through the solid cutter brace, tying all four legs together for longer, trouble-free service.

THIS PLANT MAKES ROCK BITS
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OIL TOOL CO.
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BRANCHES IN ALL PRINCIPAL OIL CENTERS IN THE UNITED STATES AND CANADA

The
INFERNO "Clamp Type" Reflex Gauge

HAS SPECIAL CLAMPS

Made of malleable iron with action applied so that force is spread over entire length of glass. There is no glass breakage due to tightening set screws unevenly. Clamps are designed so they can be removed separately. Write for Bulletin 29 for more details.

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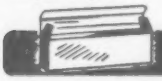
32# KRAFT RUSTPROOF FLEXIBLE METAL TIE



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Corrugated boxes for storing Empire Sand Sample Envelopes manufactured to fit your specifications. Inquiries for any size and quantity solicited.

TULSA PAPER CO.
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UNIQUE MAP OF CARIBBEAN OIL

The entire Caribbean region and adjacent territories have been covered by a single map. Drafted on a scale of 1:2,000,000, sheet size 50 in. by 38 in., to show existing oilfields, pipelines (crude, natural gas and refined products systems), refineries, concession areas, petroliferous potentials of areas available to new operators. Data covers 179 oil enterprises.

Price Folded—$10 10% DISCOUNT for
Price Rolled—$12 payment with order

LISLE *Industrial Cartography*

P. O. BOX 388, FORT WORTH, TEXAS

of the above operators' gas-condensate discovery well, 1 Breece, completed last year.

Cooper-Herring Drilling Co., Tyler, Tex., is moving a rotary rig to the recently opened Fain field, in Cherokee County, East Texas, where it will drill for R. J. Caraway. B. G. Byars, also of Tyler, contractor on C. M. Ashby's discovery well, is drilling the latter operator's second well. Pay zone of the discovery well is in Woodbine sand around 5,200 ft.

Charles Hipp Drilling Co., Graham, Tex., has a deep contract job under way in Brewster County, in the "Big Bend Country" of far western Texas. The test, 1 Roark, a rank wildcat located 25 miles south of Sanderson, is being drilled for George S. Engle. It is projected to 12,000 ft. Location is in 38-C18-TCRR Survey.

Loffland Brothers Co., Tulsa, has a new 11,500-ft. wildcat test under contract for the Shell Island area of St. Mary Parish, coastal Louisiana. It will be drilled for Lamson, Bennett & Cole of Lafayette, La., at 1 Feitel, 1½ miles northeast of the Deer Island gas field.

Homer G. Moore, Inc., Welsh, La., is the contractor on an extension test which Louisiana Land & Exploration Co. is starting northeast of the Thornwell field, in Jeff Davis Parish, coastal Louisiana. Location is at 1 Tip Top Canal Co., in 30-11s-4w. Hole is contracted to 10,500 ft.

O'Brien Drilling Co. is the contractor on Placid Oil Co.'s latest operation in the North Fouke field, Miller County, southwestern Arkansas. The test, 2 Jones, is projected to the field's Paluxy pay zone around 4,000 ft.

ACTIVE ROTARY RIGS*

(United States and Western Canada)

Area—	Week ended 3-23-53	Change week ended 3-16-53	Change week ended 3-24-52
Gulf Coast	599	+ 5	— 3
N. & W. Tex.-N. M.	837	+18	—221
Ark.-N. La.-E. Tex.	119	+ 7	— 37
Oklahoma	336	+11	+ 10
Kans.-S. Neb.	180	0	+ 15
Illinois-Eastern	98	— 2	+ 19
Rocky Mountains	182	+ 4	+ 5
Pacific Coast	159	+ 4	0
Total U. S.	2,510	+47	—212
Western Canada	172	+ 3	— 14
Total	2,682	+50	—226

*Courtesy Hughes Tool Co. Trends in drilling activity in the United States and the Pacific Coast and Illinois-Eastern areas are shown on pages 239 and 240.

J. C. Trahan, Shreveport, is contractor on a new Pettit lime extension test which Natural Gas & Oil Co. of Shreveport is starting ¾ mile northeast of present Pettit production on the Cotton Valley structure in Webster Parish, North Louisiana. The test is 1 Gleason, in 8-21n-9w. Prospective pay zone is around 5,700 ft.

Casa Grande Drilling Co., Corpus Christi, has a rig under contract to Maxima Oil Co. for a 5,000-ft. test to be drilled 12 miles northeast of Edna, in Jackson County, Texas Gulf Coast. Location is about 2 miles southwest of the North Cordele field.

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NATURAL GAS

INSPECTING ONE of the two 25,000-bbl. ammonia-storage spheres under construction at Ventura are, left to right: Rene Smith, inspector for Smith Emery Co.; A. S. Grundy, Shell Chemical assistant project engineer; and C. C. Clark, Jr., Shell Chemical inspector.

New Ammonia Plant

Construction progressing on Shell Ventura project

VENTURA, Calif. — Construction progress on Shell Chemical Co.'s ammonia plant near here is well on schedule so that the plant, which will have a capacity of 150 tons of anhydrous ammonia daily, probably will be in operation before October.

Process towers have been erected and compressor and steam-generating facilities are being installed. Erection of two 25,000-bbl. spheres for storing the plant's output of ammonia also has been completed.

Uses residue gas . . . Feed stock for the plant will be residue gas from plants of Shell Oil Co. in Ventura Avenue field.

Synthesis gas first will pass through a reformer section operating at nominal pressures and then will be compressed to about 5,000 psi. before entering the catalytic converter unit.

M. W. Kellogg Co. is constructing the plant.

Sulfur Recovery Unit in North Cowden Operating

MIDLAND, Tex.—The new sulfur-recovery unit of Stanolind Oil & Gas Co. in North Cowden field area is now in opeartion, producing in conjunction with the North Cowden gasoline plant northwest of Odessa, Tex.

The unit is designed to process 900,000 cu. ft. of hydrogen sulfide-bearing gas per day. From this amount of gas the plant is expected to recover approximately 40,000 lb. of sulfur.

The company has other sulfur-recovery units at Sundown, Tex., and in Wyoming.

Texas Eastern Deliveries, Reserves Show Increase

SHREVEPORT.—Gas deliveries of Texas Eastern Transmission Corp. rose 14 per cent during 1952 to a total of 389,651 million cubic feet, George R. Brown, chairman of the board, and R. H. Hargrove, president, revealed here.

Daily delivery capacity increased in the fall of 1952 from 740 million cubic feet to 1,200 million cubic feet with commencement of operations of a new 774-mile 30-in. pipe line and related facilities.

Additional gas reserves estimated at approximately one trillion cubic feet were attached to the Texas Eastern system with negotiation of purchase contracts of substantial volumes of new gas in Texas and Louisiana and through acquisition of a new subsidiary, Wilcox Trend Gathering System, Inc. Wilcox Trend negotiations will add approximately 100 million cubic feet of gas per day.

Natural Gasoline

Natural-Gasoline Plant to Be Built in North Dakota

CHICAGO. — Amerada Petroleum Corp. and Signal Oil & Gas Co. have announced a contract has been entered into for construction of a natural-gasoline plant by Signal in the vicinity of Beaver Lodge and Tioga, N. D. (Williston basin) to process the gas produced by Amerada with the crude oil in that region.

Under the agreement Signal will operate the plant and market the products extracted from the gas, including natural gasoline and L.P.G., returning the residual dry gas to Amerada suitable for domestic and industrial use.

A separate corporation is being formed to market the output of the plant, according to Samuel B. Mosher, Signal president. The newly formed marketing company will be headed by B. L. "Barney" Majewski, independent oil man, and president of Great American Oil Co. The latter firm will have a substantial interest in the new venture.

The plant will have an initial daily output of 150,000 gal. of natural gasoline and L.P.G., and 40 tons of sulfur. It is scheduled for completion in the fall of 1954, and the ultimate investment will be about $15,000,000 for plant, gathering lines, marketing equipment, and other facilities.

Program Set for Annual N.G.A.A. Meet in Houston

HOUSTON.—Papers scheduled for presentation at the thirty-second annual convention of the Natural Gasoline Association of America here April 29 to May 1 will cover a broad scope. Special forums and papers will include:

Laboratory procedure and analysis forum—"Fractional Analysis Techniques," S. T. Preston, instructor N.G.A.A. Fractional Analysis School, Norman, Okla.; "An Infrared-Charcoal Adsorption Method for Determining Heavy Hydrocarbons in Residue Gas," C. J. Newton, Magnolia Petroleum Co., Dallas; "Analysis of Light Hydrocarbon Gases by Fractional Adsorption," Lloyd Guild, Burrell Corp., Pittsburgh.

Corrosion in natural - gasoline - operations forum — "Economics of Natural Gasoline Plant Corrosion," E. W. Wallace, Shell Oil Co., Houston; "Stress Corrosion Cracking in Water Amine Gas Treaters," G. L. Garwood, Phillips Petroleum Co., Bartlesville, Okla.

Transportation forum — Panel discussion, "Product Pipe Lines," S. S. Smith, Shell Oil Co., New York; "Railroads," J. W. Scott, vice president, Kansas City Southern Railroad, Kansas City, Mo.; "Water Transport," Rex Phelps, Warren Petroleum Corp., Tulsa; "General Marketing," W. A. Baden, president, Anchor Petroleum Corp., Tulsa; "Motor Transport," Field Foster, Lone Star Producing Co.

LP-Gas forum—"Economics of Underground Storage Operations," Rex Phelps and W. B. Morgan, Warren Petroleum Corp., Tulsa; "Underground Storage (Present and Future)," H. R. Thomas, Stanolind Oil & Gas Co., Tulsa; "LP-Gas and the Gas Utilities," D. J. Reimers, vice president, Minnesota Valley Natural Gas Co., St. Peter, Minn.

Statistical forum—"How to Comply With the New Mineral Industry Survey Questions," Dr. Maxwell R. Conklin, U. S. Bureau of the Census, Washington; "More Cooperation for Better Statistics," Donald Colby, U. S. Bureau of Mines, Washington.

Deep extraction for ethane and propane—"Natural Gas as a Base for Petrochemicals," David J. Stark, National Petro-Chemicals Corp., Tuscola, Ill.; "Thermodynamic Data Required for Deep Extraction," Dr. D. L. Katz and Dr. Brymer Williams, University of Michigan, Ann Arbor; "Plant Economics Vs. Increased Cost of Natural Gas," Harold E. Vaughan, Continental Oil Co., Houston.

Operations forum—"Absorption Index—A Simple Test for the Determination of an Important Property of Natural Gas" and "Approximating the Hydrocarbon Composition of Natural Gas From Absorption Index and Specific Gravity," T. W. Legatski, J. W. Tooke, and L. A. Grundy, Phillips Petroleum Co., Bartlesville, Okla.; "Field Correlations of Specific Gravity and Gasoline Content of Natural Gases," Dan T. McDonald, Magnolia Petroleum Co., Dallas; "Charcoal Weight Method for Determining the Propane and Butane Plus Fractions of Natural Gas," C. D. Gard, Union Oil Co. of California, Los Angeles.

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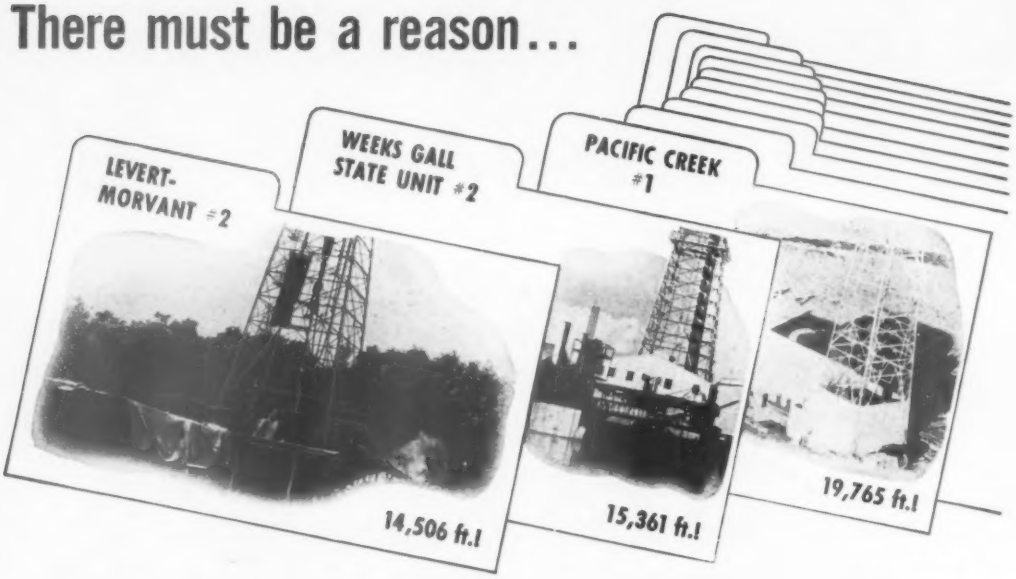

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EXPLORATION

There's No Oil in Dimwitt County

by Philip C. Ingalls

DIMWITT County is in that area of Texas which lies south of the Red River and north of the Rio Grande. Near the center of this remote county there's a sizable field called Shelder, which never has and never will produce a drop of oil.

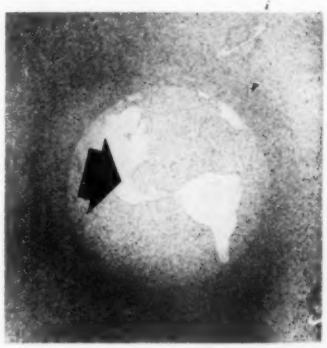
Shelder field was discovered three years ago by Tom Barber of Stanolind Oil & Gas Co., Houston. Barber, however, modestly credits the discovery to Stumble Oil Co., an imaginary "major" with the best of oil-finding talent and equipment.

In a paper on Shelder, Barber states that the field is representative of those fields discovered during the period of change from the old to the new method of exploration. The old way, he says, was to find the highest hill and drill till the money ran out; the new way is to pick a spot that appears favorable for the accumulation of oil as indicated by whatever unscientific reason may be at hand, survey it with every known geological and geophysical method, but under no condition drill it.

During the past 2 years Barber has entertained many groups of geologists with his highly humorous and unmaliciously satirical discussion of this nonexistent oil field. He has produced roars of laughter by altering but slightly the statements and methods of illustration all too commonly used by many of those who have presented papers on oil fields.

Tom Barber has been exposing audiences to a lesson that should not be taken lightly. That lesson is that oral papers on oil fields can be, to put it politely, rather boring, slightly dull, and often just plain worthless.

Even at regional geological meetings the audience is composed of geologists from far and wide and, though nearly all may have some interest in a given field, there are few fields in which 1 out of 100 listeners is interested in such facts as: (1) The Schwagerina longissimoidea, with an axial section tangential to the proloculus shown in slide 107, is diagonostic of the 1,600-ft. zone, found at 4,233 ft. in well 6-A, which lies 1,415½ ft. north 42° west from the northsouthsideways middle of section 102 in Dambastit County, Oklahexas; (2) up to February 29, 1953, exactly 47,538½ ft. of hole had been drilled in the field.



"... Shelder field is located 96,000,000 miles away from the sun, as shown by place-fix map."

There is no intention here to discredit oil-field papers. A great deal of knowledge of the geologic profession has been preserved through the writing of just such papers. They are the keys to the discovery and development of future fields. These papers should contain every bit of information known about a field even though it may not seem important at the time. However, these detailed papers should be restricted to the printed form, not forced on a captive audience. All too often by the end of the description of the sixth Miocene sand, which differs from the previously discussed five only because it is 232 ft. deeper than the fifth, this audience is composed of those few geologists who, out of sympathy for the speaker or fear of running into their boss at the coffee bar, have hesitated to leave the room.

Many geologists feel that oil-field papers presented at geologic meetings should be restricted to an expanded K. K. Landes type of abstract* with a few well-chosen slides that tell a story in themselves. This feeling is especially prevalent after hearing Barber's paper for now these geologists are convinced they are not alone in thinking that oral presentations can and should be improved.

If 1-hour oil-field papers were given in 15 or 20 minutes the entire audience would find them rewarding, and the few who want to know more about the field would have notice that this paper is soon to be available for study in printed form. Furthermore, there would be more time for discussions of the geology of areas where oil is being and will be found as contrasted to a dull description of the geology below 1,200 acres where Stumble Oil already has found all of the oil.

* See A.A.P.G. Bulletin, July 1951.

HIGHLIGHTS OF WEEK'S DEVELOPMENTS

NORTH DAKOTA . . . Ward Williston Drilling Co. reported recovery of 80 bbl. of oil in 5 hours at 1 Klokstad, NE NW 36-164n-79w, in the Turtle Mountain area of Bottineau County. This is the best of a series of tests at this wildcat.

COLORADO . . . Forest Oil Co. recovered 3,300 ft. of gas-cut oil, 90 ft. of oil and gas-cut mud in 1½ hours on test of the interval 5,272-82 ft. at 1 Causey, NE SW NW 23-2s-57w, Adams County wildcat. Total productive interval in the lower "D" sand is 41 ft.

WEST TEXAS . . . Texas Gulf Producing Co. 2 Headlee, northeast offset to the Ector County Ellenburger discovery, was running 123 ft. high to the discovery on the Devonian at 11,340 ft. Elevation is 2,917 ft. Drilling continued without testing.

KANSAS . . . Atlantic Refining Co. has recovered free oil from two zones in the Marmaton at 1 Hall, C NW SE 36-23s-22w, rank Hodgeman County wildcat, 14 miles east of Purdyville pool. A drill-stem test from 4,283-4,317 ft. recovered 3,390 ft. of free oil.

WILDCAT COMPLETIONS, FEBRUARY 1953

	Total	Oil	Gas	Dry	Footage	1953 Total comp.	1953 Cum. (1,000 ft.)	1952 Total comp.	1952 Cum. (1,000 ft.)
Kansas	65	8	5	52	243,845	164	612	152	599
Oklahoma	47	7	3	37	235,853	118	546	121	590
Texas	400	78	10	312	1,945,551	870	4,166	865	4,159
North Central	171	41	1	129	631,521	370	1,353	392	1,356
West	58	11	0	47	317,390	136	815	136	767
Panhandle	0	0	0	0	0	10	45	16	99
East	24	3	0	21	123,640	49	244	40	234
Gulf Coast	53	13	2	38	452,000	125	980	133	1,002
Southwest	94	10	7	77	421,000	180	729	148	701
Louisiana	33	3	1	29	291,743	76	654	52	445
North	8	0	0	8	41,620	28	168	21	106
South	25	3	1	21	250,123	48	486	31	339
Mississippi	15	1	0	14	124,000	34	268	36	272
Arkansas	8	3	0	5	38,439	18	83	13	62
Nebraska	10	4	0	6	52,950	25	130	26	92
Rocky Mountains	42	3	0	39	246,535	106	595	56	315
Dakotas	3	0	0	3	26,523	11	66	1	3
New Mexico	15	1	2	12	100,500	32	213	16	104
California	52	4	1	47	248,450	107	499	94	450
Tri-States	53	9	0	44	98,037	145	292	188	357
Others	31	2	0	29	103,072	76	261	74	225
Total Feb. 1953	774	*123	22	629	3,755,498	1,782	8,385	1,694	7,673
Total Jan. 1953	1,008	141	29	838	4,629,832				
Cum. 1953	1,782	264	51	1,467	8,386,330	1,782	8,385		
Cum. 1952†	1,694	243	45	1,406	7,672,700			1,694	7,673

*Includes 6 condensate wells: Texas Gulf Coast 3, Southwest Texas 3. †Revised.

Completions Drop But Total Still Ahead of Last Year

Rocky Mountain area registers 90 per cent gain over same period last year. Dakotas also spurt

by John C. McCaslin

THE usual midwinter slump and the short month were the factors in the low number of wildcat completions reported in the country during February.

Operators finished the second month of the new year by finaling 774 wildcats, 145 of them successfully. Despite the slump noted during the month, which is usual for February, the year's cumulative figures are up slightly over last year's totals. New discoveries and dry holes completed by wildcatters show an over-all gain of 88 wells and 712,630 ft.

The most important gain recorded in wildcat completions was in the Rocky Mountain area. There, wildcat completions showed a 90 per cent gain over the same period last year, while wildcats drilled in the Dakotas showed a 100 per cent gain.

Denver-Julesburg basin . . . This area in northeastern Colorado and western Nebraska is enjoying the most successful wildcat campaign in its history with six new discoveries recorded this year, and eight apparent discoveries in the making. The most important discoveries were made in Washington, Weld, and Adams counties, Colorado, and Cheyenne County, Nebraska.

Weld County's two important finds were the Roggen area strike that moved commercial production farther toward the central and deeper portion of the basin, and the recovery of Permian oil at a Keota field well recently. In Cheyenne County, Nebraska, Nichols pool was opened, and has indications of becoming of the Huntsman-Dorman caliber. The field has two producers and two new wells in testing stages.

The basin's most important development activity this year has been at Little Beaver field in Washington and Adams counties. The field has emerged as one of the potential big fields in the basin, having the largest proven acreage of any Denver basin pool in Colorado. The field has 15 "D" sand producers and a possible new pay in the lower "D" sand. The latest discovery in the area was made recently by Forest Oil Co. at Badger Creek, where the operator established a 28-ft. saturated "D" sand section 4 miles southwest of Little Beaver field.

Williston basin . . . A discovery of potential importance to the Williston basin was made in the Cabin Creek area of Fallon County, Montana, on the Baker-Glendive anticline.

Shell Oil Co. recovered the first significant showings of oil from the Mississippian (Charles-Madison) on the anticline. The company recovered 4,400 ft. of 32.5°-gravity oil from the Mississippian at 22-23 Unit. The indicated success would establish the second Madison producing area in the Montana portion of the basin, the other being at Woodrow.

The Cabin Creek wildcat, which is drilling ahead, is about 15 miles southeast of Pine Unit, a Devonian-Ordovician field, and northwest of Little Beaver pool, also an Ordovician producer. The Mississippian-Madison is the principal producing formation in the Williston basin to date.

The Westhope area of northeastern North Dakota holds considerable promise for shallow production on the northeastern edge of the Williston basin, but more wells and better completion practices are necessary in order to evaluate the potentialities of this region. Activity during the winter slowed down considerably with production tests still under way at three indicated shallow discoveries in the area. As more drilling is done in Bottineau County much will be learned of the possibly oil-bearing structures that underly the vast glacial-debris-covered, hard-to-prospect area.

West Texas . . . Significant developments of the month in West Texas included the rapid development of North Bronte, a multipay field in northeastern Coke County that is expected to be the forerunner of a number like it on structural highs known to exist on a north-south trend. Following discovery in the Pennsylvanian, offsets and extensions in a straight line north added five additional pay sections, including the Ellenburger and the Hickory sand of Cambrian age. Location of the area is on the Eastern platform of the Permian basin.

California . . . In Los Angeles basin, Union Oil Co. 1 Lindauer was completed as a 100-bbl. producer in 600 ft. of Miocene section above 4,855 ft. to extend production along the Brea-Sansinena trend 1 mile northwest. The discovery is about midway in the 2-mile stretch which separates Sansinena field from Naranjal pool discovered last year.

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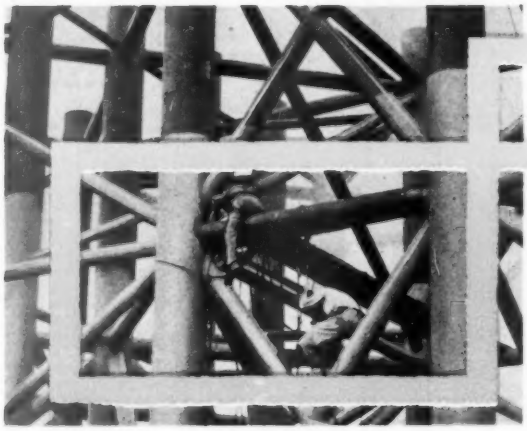

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Photos courtesy of Minnesota Mining & Manufacturing Company, Detroit 2, Mich., whose COROGARD coating system, based on VINYLITE Resins, was used to coat this 10-well installation, and to repaint the structure where oil-base marine paint failed.

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Midwinter Slump Slows Activity

by John C. McCaslin

THE usual midwinter slump in drilling and severe winter weather in some areas accounted for the drop in completions in February. Total completions in the United States showed a 14 per cent decline from the previous month, but were down only slightly from February 1952. The total 3,492 wells completed during the month was lowest since last September. Of the total 1,828 were oil wells, 254 gas wells, and 1,410 dry holes. Total footage for the month was down considerably.

Cumulative total completions for 1953 show a 171-well decline from last year's figures. Only dry holes drilled show an increase over 1952's figures. Cumulative footage for 1953 stands at 30,609,444 ft., down slightly from 1952. However, increased drilling activity in many areas recently, particularly in West Texas, the Texas Gulf Coast, and Oklahoma, points to arise in completions during March.

Only two areas in the nation reported completion increases, Pennsylvania and the southeastern states. The most noted drop in completions was in the Rocky Mountain areas, where the worst blizzard of the winter slowed operations in many parts of the region, reducing the number of new starts, both wildcat and development, and completed wells. One week during the month showed the first instance of an active rotary count of fewer than 200 in the region since early 1952.

The trend toward deeper drilling is evident again this year. A continual drop in the number of wells completed under 2,500 ft. has been noted for several years. In West Texas, particularly, a trend toward deeper drilling in and around older producing areas is reported, and the rising importance of Ellenburger production in that area is adding new records to deeper depth classifications. A slight drop in wells completed in the 10,000-12,500-ft. classification, however, is reported for the first 2 months of this year, while in the 5,000-7,500-ft. classification a considerable decline is noted.

Completions in western Canada remained rather constant despite the midwinter slump in over-all drilling. Saskatchewan and British Columbia were the only provinces showing a decrease. The Williston basin area of Saskatchewan had an active winter, especially in the Wapella area, where eight wells are now on production from the Wapella sands.

SUMMARY OF COMPLETIONS, FEBRUARY 1953

	Total comp.	Oil	Gas	Dry	Under 2,500 ft.	2,500-5,000 ft.	5,000-7,500 ft.	7,500-10,000 ft.	10,000-12,500 ft.	Over 12,500 ft.	Total footage	Rigs and drilling
New York	58	30	0	28	58	0	0	0	0	0	83,800	66
Pennsylvania	139	66	12	61	130	5	4	0	0	0	233,000	160
West Virginia	49	5	33	11	25	20	4	0	0	0	135,781	172
Maryland	0	0	0	0	0	0	0	0	0	0	0	5
Ohio	69	23	14	32	40	27	2	0	0	0	152,519	168
Kentucky	75	19	22	34	52	23	0	0	0	0	160,297	146
Illinois	140	63	0	77	53	87	0	0	0	0	350,091	253
Indiana	61	31	0	30	45	16	0	0	0	0	115,973	104
Michigan	32	9	2	21	19	13	0	0	0	0	77,113	99
Kansas	351	175	26	150	52	293	6	0	0	0	1,176,223	464
Nebraska	16	6	0	10	0	6	10	0	0	0	86,695	22
Oklahoma	508	330	19	159	164	227	82	27	7	1	1,828,260	572
Texas	1,309	692	87	530	285	496	330	159	32	7	6,002,355	1,216
N. Central (Dist. 7-B & 9)	484	250	5	229	174	217	92	1	0	0	1,646,404	319
West (Dist. 7-C & 8)	266	188	2	76	37	96	87	31	10	5	1,337,087	321
Panhandle (Dist. 10)	76	41	25	10	8	59	6	3	0	0	271,454	86
East (Dist. 5 & 6)	61	19	9	33	6	22	25	8	0	0	324,046	81
Gulf Coast (Dist. 2 & 3)	183	85	23	75	10	42	60	56	13	2	1,218,828	233
Southwest (Dist. 1 & 4)	239	109	23	107	50	60	60	60	9	0	1,204,536	176
Louisiana	209	112	17	80	43	16	32	48	51	19	1,554,807	283
North	75	44	6	25	38	8	20	8	1	0	282,987	83
South	134	68	11	55	5	8	12	40	50	19	1,271,820	200
Arkansas	29	14	1	14	2	18	7	2	0	0	125,271	31
Mississippi	29	9	0	20	0	2	20	2	5	0	208,494	24
Ala.-Ga.-Fla.	15	3	0	12	3	10	2	0	0	0	69,134	14
Montana	26	12	0	14	2	12	7	4	1	0	133,293	55
Wyoming	40	21	0	19	4	15	12	8	1	0	218,688	115
Colorado	36	13	2	21	0	13	22	1	0	0	194,157	66
Utah	4	0	0	4	0	1	0	2	1	0	30,396	36
New Mexico	76	37	16	23	13	23	12	12	12	4	471,916	274
California	199	144	3	52	57	73	44	12	13	0	906,307	272
North Dakota	22	14	0	8	0	0	2	19	1	0	187,260	29
Miscellaneous	0	0	0	0	0	0	0	0	0	0	0	§12
Total February 1953	3,492	†1,828	254	*1,410	1,047	1,396	598	296	124	31	14,501,830	‡4,658
Total January 1953	3,969	1,957	275	1,737	1,143	1,681	709	298	113	25	16,107,614	4,945
Cumulative 1953	7,461	3,785	529	3,147	2,190	3,077	1,307	594	237	56	30,609,444	.....
Cumulative 1952¶	7,632	4,088	532	3,012	2,257	3,047	1,504	528	249	47	31,811,348	.....
Western Canada	140	75	15	50	20	70	43	6	1	0	591,341	.....
Alberta	102	55	13	34	17	39	40	5	1	0	458,861	.....
Saskatchewan	34	20	2	12	3	28	2	1	0	0	116,253	.....
British Columbia	2	0	0	2	0	1	1	0	0	0	10,132	.....
Manitoba	2	0	0	2	0	2	0	0	0	0	6,095	.....

*Incl. 96 service wells: N. Y. 28, Pa. 55, Ky. 1, Ind. 1, Kans. 4, Okla. 7. †Incl. 37 condensate wells: Okla. 2, W. Tex. 3, E. Tex. 1, Tex. Gulf Coast 8, S.W. Tex. 17, S. La. 6. ‡Incl. all wells rigged up and/or drilling at month end. §Incl. Idaho-Ariz.-Nev. 10, S.D. 2. ¶Revised.

KANSAS

Oil Discovery Reported In South Salina Basin

A Maquoketa dolomite discovery is reported between Salemsburg and Olson pools in the southern part of the Salina basin, south of Smoky Hill Airforce Base near Salina, Kans.

National Associated Petroleum Co.'s 1 Olson, C NW SW 8-16s-3w, Saline County, produced 200 bbl. of oil per day following acidization at 3,440 ft. in the Maquoketa dolomite which overlies the Viola of Ordovician age.

This discovery, along with recent drilling activity in Smolan pool, has further increased interest in the Salina basin of Kansas. This

Star Indicates New Saline Strike

basin covers an area of about 41,000 sq. miles of northeastern Kansas and southeastern Nebraska, but has no production except along its southern margin. The basin is bordered on the southwest by the Central Kansas uplift, on the east by the Forest City basin with the Nemaha granite ridge separating the two basins. The Chautauqua arch runs northeast-southwest along the southeastern edge of both these basins.

Sediments in the basin consist of: (1) pre-Pennsylvanian rocks, which are composed of marine limestone, dolomite, and chert, with sand in the Simpson and a basal sand above the granite; (2) Pennsylvanian and Permian age rocks of interbedded thin marine shale and limestone; and (3) Cretaceous sediments composed of marine shale with thin limestone beds and the thick Dakota sandstone at the base. Maximum depth of this shallow sedimentary basin is about 5,000 ft.

The Salina basin was opened to oil production in 1926 at Lost Springs pool in Marion County in the Mississippi lime. The first gas production in the basin was established in Morris County in 1928 from a shallow Pennsylvanian sand.

Saline County has 12 producing pools currently. Two new pools were opened last year. The county's pools reported 62 new oil wells last year, while so far in 1953 the county has 22 new oil wells. The new Olson discovery is the year's first new pool for the county. Marion and Morris counties had 19 new oil wells last year. Producing formations in the Salina basin include the Viola, Maquoketa, Mississippi lime, Burgess sand, Lansing-Kansas City limestone, Oswego limestone, and Pennsylvanian sands ranging in depths from 450 to 3,375 ft.

Recently a rank wildcat was staked in the basin in Mitchell County by Murfin Drilling Co. at 1 Stillwell, SW SW NW 12-6s-6w. Nearest production is 50 miles to the south-

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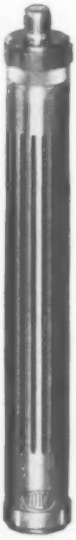

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east at Salina pool. National Associated has a wildcat drilling below 3,900 ft. in Mitchell County at 1 Thiessen, SW SW SE 15-6s-9w. In Saline County there are currently two wildcats drilling and 15 field wells under way.

Second Pay Found at Pratt County Test

Champlin Refining Co. has another pay zone indicated at their 1 Henderson, SW NE NW 11-26s-14w, Pratt County, south-central Kansas. Recovery on a drill-stem test of the Simpson from 4,358-65 ft. was 630 ft. of clean oil. Previously a test from 3,920-30 ft. in the Lansing recovered 1,140 ft. of oil.

The possible pool opener is located 1 mile southwest of Moore pool and 5 miles northwest of Chance pool in northern Pratt County.

Elsewhere in Pratt a rank wildcat is drilling 11 miles west of Chance pool. The test is Tatlock Oil Co.'s 1 Curtis, SE SE NE 21-26s-15w. The new test is located in the northwest corner of the county.

Free Oil at Hodgeman Test

A rank wildcat 14 miles east of Purdyville pool production in Hodgeman County has recovered 3,390 ft. of free oil from the Marmaton (Pennsylvanian).

The new indicated discovery is located in the C NW SE 36-23s-22w in the eastern part of Hodgeman County, which is located in the Dodge City embayment of western Kansas. On drill-stem test from 4,283-4,317 ft. in the Marmaton Atlantic Refining Co.'s 1 Hall recovered the free oil with 1,470 psi. bottom-hole pressure and 1,150 psi. flow pressure. Operator is drilling below 4,360 ft.

MICHIGAN

Arenac Operations Shut Down By High Water

Results of testing were still inconclusive this week at the Jack Uhl 1 McFarlan, NE NW SW 34-20n-3e, Moffatt Township wildcat, Arenac County, and operations were shut down due to high water conditions on the lease and around the well.

A servicing machine will be moved to wellsite as soon as high water subsides to allow for pulling rods and pump. Well has been on the pump for several days, but all indications are that pump has "fouled" and will have to be pulled for repair. While rods are out of the well, about 500 gal. of acid will be employed. To date this possible new Dundee discovery has produced about 133 bbl. of oil. Well was swabbed for 2½ days during which time about 115 bbl. of oil, plus some water showed. An additional 15 to 18 bbl. of oil were recovered during pump tests. Wildcat is being tested in the Dundee at 2,988 ft., total depth. Top of Dundee was logged at 2,911 ft., and pay zone showed starting at 2,984 ft. to the total depth.

A new shallow Traverse wildcat well in Porter Township, Van Buren County, showed some promise after acid treatment. The W. D. Garnett & Norman L. Stevens 1 Tauber, SE NE SW 8-4s-13w, swabbed 10 bbl. of fluid an hour for 5 hours after being acidized in the Traverse with 1,000 gal. Top of Traverse lime was logged at 1,177 ft. and hole was drilled to 1,180 ft. where well showed about 300 ft. of fluid, oil and water, natural. Well was plugged back to 1,178½ ft. before being acidized and additional plug-back of about six inches more was scheduled in an endeavor to shut off more of the water sand showing.

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NEW MEXICO

SOUTHEAST NEW MEXICO

Continental Well is Devonian Discovery

A roundup on exploratory drilling in northern Lea County lends considerable support to the theory of a deep producing trend up the western side of the Midland basin. Pre-Permian discoveries, or significant extensions, are numbered on the accompanying map.

1. Operations were again under way at Continental Oil Co. 1 Anderson Ranch, 11-16s-32e, southwest of the South Saunders field, which caught fire while testing a lower Pennsylvanian sand.

On a drill-stem test in the Devonian at 13,373-408 ft., Continental's discovery flowed the water blanket in 1 hour and 23 minutes, cleaned itself in 53 minutes, and was then turned into tanks. An 11-hour gage tanked 409 bbl. of 54° oil, with no water. Size of tubing choke, if any, was not reported.

Operators were drilling ahead at 13,485 ft., still in the Devonian on which top had not been picked. Rig belongs to Carl B. King Drilling Co., and contract depth was 14,000 ft.

This well also had flowing oil in the Wolfcamp of the lower Permian, and gas in a Pennsylvanian sand. It marks the second Devonian discovery for western Lea County, being 8 miles north and 4 miles east of Buffalo Oil Co.'s Devonian well in the shallow Maljamar field.

2. B. L. & Associates (formerly reported as Wilshire Oil Co., Inc.), 21-8 Harbison, 8-14s-37e, northwest of the Denton field, swabbed and flowed 254 bbl. of 44° oil on a 24-hour test through perforations in the lower Pennsylvanian at 11,580-90 ft. At last report, operators were swabbing fluid and some new oil from perforations at 11,595-600 ft.

3. Amerada Petroleum Corp. 1 Schenck, southwest extension try to the Bronco-Devonian field in Yoakum County, Texas, was drilling ahead after testing on perforations in the Devonian.

At 11,825-65 ft., recovery in 3½ hours was water blanket cut with oil. On test from 11,865-915 ft., water blanket flowed in 3 hours and 35 minutes. Length of time for oil to surface was not reported, but when turned into tanks the well flowed 19.17 bbl. of oil in 2 hours and 50 minutes. Oil in the pipe was reversed out, and recovery below the circulating sub was oil-cut mud with no formation water.

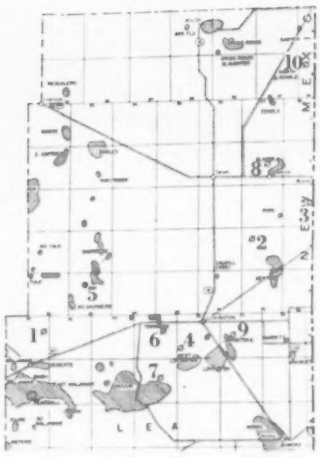
Lowest formation marker so far reported is the Mississippian at 10,655 ft., by samples, and on elevation of 3,810 ft.

4. Lawton Oil Corp. 1-L State-Sinclair, 30-16s-36e, promised another Pennsylvanian link in the series of such fields starting with the area on the east side of the Lovington field, northwest to Saunders, then north through Lazy J, Hightower, Bagley and Mescalero; all on the west side of Lea County.

First tests on perforations at 11,430-88 ft. produced water along with oil, which operators believed was coming through channels in the cement, rather than from the section on test. Later reports credited the well with a gage of 263.5 bbl. of oil with no water in 21 hours, through ¼-in. choke, and from the same perforations. Nearest production, at West Lovington, is from the San Andres.

5. Cities Service Oil Co. 1-AG State in 9-15s-33e extended Pennsylvanian production to the southwest, on the south end of the Saunders field, but its potential indicated a marginal well. Completion test, on the pump, produced 41 bbl. of oil plus 16 per cent water, from perforations around 9,883-93 ft. Total depth was 10,078 ft. and top of pay was 9,883 ft.

6. Pure Oil Co. 1-B Lea State, 10-16s-35e, southeast of Abo (Wolfcamp), production in the Townsend field, was running a drill-stem test in the Pennsylvanian between 10,609-97 ft., following a core which recovered fluorescence and odor. The interval was believed to



Exploration throughout Southeast New Mexico has continued at high level over the past year. Numbers on map of Lea County are pre-Permian tests, and many are indicating discovery production.

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be of Cisco or Canyon age. Sample top on the Wolfcamp was 9,490 ft., minus 5,476 ft.

7. Humble Oil & Refining Co. 1 State, 11,000-ft. wildcat just north of San Andres production on the east side of the Vacuum field, tested shows of oil in a section believed to be Wolfcamp, and was drilling ahead. A 1½-hour test at 9,570-9,610 ft. produced a strong blow of gas in 45 minutes and recovered 510 ft. of heavily oil and gas-cut mud, 60 ft. of free oil and 20 ft. of salt water.

8. Shell Oil Co. 1 Selman, 22-12s-37e, west extension try to the Gladiola-Wolfcamp field, developed salt water on a 2-hour test at 9,777-9,852 ft., believed to be in the Permo-Pennsylvanian. Operators were conditioning hole for further testing.

9. Tide Water Associated Oil Co. et al 1-B Monteith extended Strawn production in a new area. A drill-stem test from 11,294-314 ft. had flowing oil in 39 minutes, which was reported as flowing 25 bbl. hourly. A core from 11,316-35 ft. indicated 13 ft. of additional pay, and a test from 11,315-35 ft. had oil in 25 minutes, gaging 60.3 bbl. in 2 hours. It was to core ahead.

10. Rowan Oil Co. 1 Simmons-Federal, 8-10s-38e, was drilling ahead at 11,685 ft. in Mississippian limestone, with no shows reported. Projected depth was 12,000 ft. Top of the Mississippian was tentatively placed at 10,616 ft.

CANADA

Four New Strikes Reported In Western Canada Areas

Another Alberta wildcat discovered crude oil this week, boosting to four the number of indicated oil or gas strikes in Alberta and Saskatchewan for the past 7-day period, and raising to 41 the indicated discoveries for western Canada during the initial 79 days of 1953.

The west's discovery rate so far this year is nearly one new find every two days, and includes 27 indicated oil and gas discoveries and 14 with natural gas. Over 85 per cent of the new potential discoveries were made in the nation's No. 1 oil province, Alberta, which chalked up 21 with oil and 14 with gas. Exploration in Saskatchewan accounted for the balance of the new finds, six that indicated possibilities of oil production. Neither Manitoba or British Columbia have as yet recorded their first 1953 discovery.

The most recent discovery in the west was made by Amurex Oil Development Co. in the Denhart area of southern Alberta, 10 miles east of Princess town, 25 miles east-northeast of Brooks and 115 miles east-southeast of Calgary. Amurex struck approximate 25°-gravity crude oil in the Madison limestone at a wildcat being drilled on a 40,000 acre crown reservation acquired under farmout agreement from John Crossi and associates of Calgary and Los Angeles.

Amurex 1-6 Denhart, LSD 6, 33-19-10w4, is 2 miles southeast of Los Angeles Alberta 2 Pete capped gas discovery well and about that same distance west of Anglo 1 Rainy Hills abandonment. Top of the Madison limestone was entered at 3,306 ft., or 732 ft. below sea level (K. B. elevation 2,574 ft.), and crew cored to 3,320 ft. The main porous zone was between 3,306 to 3,314 ft. One-hour drill-stem test was run from 3,305 to 3,320 ft. through ¼-in. choke. There was a good initial air blow, with gas to surface in 16 minutes, at rate too small to measure. One-hour pipe recovery was 390 ft. of clean oil, no water. Hydrostatic pressure was 1,800 psi.; flowing pressure, 250 psi.; shut in, 1,400 psi. Crew was coring ahead at week end report.

Another prospective oil find this week was drilled by Amurex, and is in the Crane Lake area of southwest Saskatchewan, 11 miles northeast of Maple Creek. This well, Amurex-Albercan 1-4 Russell LSD 4, 34-12-25w3, on farmout from Albercan Oil Corporation (subsidiary of Canada Southern Oils, Ltd.), gave up oil encouragement in two formations —the Jurassic sand and Charles limestone. The Jurassic indicated an 18-ft. porous sand section with spotted saturation throughout, while the Charles, which came in at 3,680 ft., yielded a small amount of free oil during drill-stem tests. Results of tests in both formations have not as yet been released. String of production casing has been run through the Charles, preliminary to perforating, acidizing and testing that section, in an effort to determine whether it will produce in commercial volume.

The third oil discovery during the third week of March was recorded in Alberta, in the Namao-Campbell area. Light gravity oil came at the Maygill-Hy Charger-Henderson Holdings & associates' step-out test which is nearly 1 mile southwest of previous oil production. The well, Maygill-Hy Charger 1 Henderson Holdings, LSD 7, 34-54-25w4, indicated discovery of a separate structure, on the basis of drill-stem tests near the 3,720-ft. level. Oil success was assured during those Basal Cretaceous drill-stem tests, and production string of casing has been run for completion.

This week's gas discovery well was drilled by Imperial Oil, Ltd., near the Vimy and Legal railpoints, 32 miles north of Edmonton. This well, Imperial 6-29 Calmette, LSD 6, 29-58-25w4, flowed natural gas at rates ranging up to 3,175,000 cu. ft. daily during drill-

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stem tests in the Viking sand between 2,632-42 ft. Hole completed drilling at 2,770 ft., after entering formation water, and has now been capped as a potential gas well, awaiting market outlet.

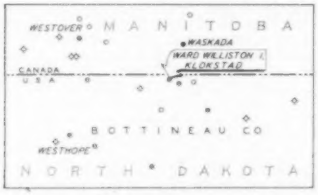
This gasser lies some 6 miles north of other oil and gas production in the Legal area of central Alberta.

ROCKY MOUNTAIN

NORTH DAKOTA

Turtle Mountain Wildcat Has Best Tests Yet

Ward Williston Drilling Co. has run a series of four tests at 1 Klokstad, NE NW 36-164n-79w, in the Turtle Mountain area of Bottineau County, with recovery of oil at a 16 bbl. per hour rate on the best of the series.



Best tests yet reported at Turtle Mountain wildcat in Northeast Williston.

The wildcat showed for possible commercial production some time ago, but tests were postponed due to weather conditions and the necessity of moving in cable tools for completion. On test of the open hole interval 3,071-81 ft. the well flowed and swabbed 80 bbl. of oil in 5 hours. Total recovery on the four tests was 290 bbl. of oil. The wildcat is now shut in pending installation of pump and other completion facilities.

Croff Area Confirmation Dry

Amerada Petroleum Corp. has abandoned 1 Croff, C NE NW 11-149n-96w, in McKenzie County, second unsuccessful attempt at confirmation of the discovery in this area. Total depth of the well was 11,685 ft. and the Madison zone 9,454-80 ft. was the principal section tested. The well made only load oil and sulfur water on test of this interval. Amerada has two other wells now drilling in this area.

MONTANA

Shell Unitizing New Baker-Glendive Area

Shell Oil Co. is unitizing the Iron Bluff area of Wibaux and Dawson counties in Townships 13 and 14 north, Ranges 55, 56 and 57 east, and just northwest of Pine Unit field where the company now has five producing wells.

Shell has been successful in establishing fields at Little Beaver, Fallon County, and Pine Unit, Wibaux County, and indications are that these two southern Baker-Glendive fields will be among the best on the long structure. Shell is also drilling ahead in a third apparent discovery in this portion of eastern Montana at 1 Unit, NW SE NW 33-10n-58w, in the Cabin Creek area, Fallon County.

Current depth of this wildcat is below 8,169 ft. The Cabin Creek discovery is the first to establish commercial production from Madison (Mississippian) along the anticline. At the present depth the well is believed to be below Mississippian, and some shows have been reported from intervals 7,376-7,423 ft. and 7,725-7,865 ft. Recovery on these tests show oil-cut mud and water. Both Little Beaver and Pine Unit production is from formations older than Mississippian, indicating the possibility of additional pay zones in this discovery which has already given indication of major importance in Madison zones.

Both The Texas Co. and Northern Pacific Railroad hold acreage in the new unit in the Iron Bluff area. Shell will be operator, and has announced no locations to date.

COLORADO

Keota Deep Test Has Lower Permian Show

Sherrod & Apperson, Tulsa independents are reported to have had shows in Big Blue of Lower Permian age at 8 Gillette, C NW NW 9-9n-61w, in Keota field, Weld County, Colorado. This wildcat, a deepening of a Dakota failure, attracted wide attention several days ago with recovery of the first significant quantities of oil from pe-Cretaceous beds within the Denver-Julesburg basin. Early recovery was reported as from the Lyons sandstone.

Current reports, which are unofficial, since the operation is a tight hole indicate that staining was encountered from about 9,100 ft. to the present depth below 9,152 ft., and that drill-stem test of the interval 9,119-52 ft. recovered 80 ft. of mud with specks of oil in 35 minutes. While the recovery is not of itself significant the establishment of the developed section of Big Blue in this area of the basin is regarded as important.

Pre-Cretaceous oil possibilities of the basin have been only sparsely investigated, and the shows reported from this well are considered of major importance to future work in the area.

Ginther-Warren-Ginther of Houston have announced the deepening of 1 Fritz, C SE NE 36-14n-64w, Laramie County, Wyoming, to test the Lyons sand. This well is approximately 24 miles north of the apparent discovery at Keota, and the decision to deepen has been announced since the recovery of Permian oil in the Colorado deep test. The Wyoming wildcat is at 7,500 ft., and the operator estimates an adidtional 1,500 ft. of hole will be necessary to top Lyons.

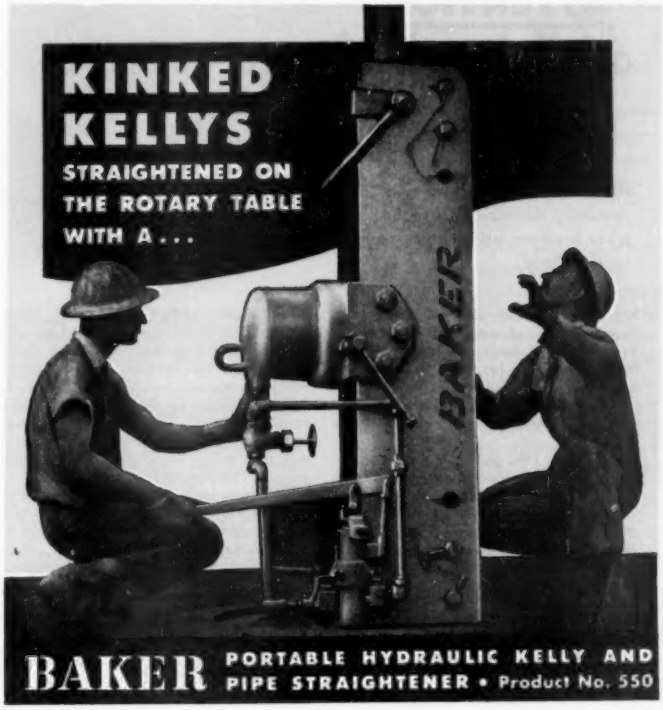
On the southwestern flank of the Denver-Julesburg basin further work in the Forest Oil Co.'s 1 Causey, NE SW NW 23-2s-57w, Adams County, has recovered additional oil from "D" sand, but topped "J" sand without shows in that formation. The well made 3,300 ft. of gas-cut oil and 90 ft. of gas-cut mud in 90-minute test of the zone 5,272-82 ft. The productive "D" sand section in this important discovery now totals approximately 41 ft.

"J" sand was topped at 5,304 ft. and at last report Forest was coring at 5,402 without shows.

NEBRASKA

Discovery Indicated Northwest of Sidney

The Chicago Corp. and Republic Natural Gas Co. recovered 2,724 ft. of clean oil and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gas at the rate of 124,000 cu. ft. per day from 1 Doran Farms, NE NE SW 27-14n-50w, about 3 miles northwest of Sidney, Cheyenne County, for another apparent discovery in this area. Tops have not been released by the operator, but the recovery is believed to be from "D" sand. The wildcat is located on land farmed out from Ohio Oil Co., and is one of several discoveries by these operators on Ohio farmouts during the past 12 months in this area.

WYOMING

Walker Dome Discovery Has Good Flow on Tests

After treating Phosphoria with 10,000 gal. of acid at 1 Mill Iron Land & Cattle Co., SE NE NE 8-46n-99w, Hot Springs County, Forest Oil has reported recovery of 12 bbl. of oil per hour on swab tests. The wildcat is the first deep test of Walker Dome, northwest of Grass Creek field, and is on land farmed out by Ohio Oil, one of the major operators in this southern Big Horn basin area. Test was of the perforated zones 6,646-78, 6,686-6,720 and 6,730-50 ft. The wildcat was drilled to Tensleep, which showed water on tests, and was plugged back for completion in Phosphoria.

KENTUCKY

EASTERN KENTUCKY

A new wildcat and the first in several years has just gotten under way in Carter County. Wolf Creek Oil Co. is drilling at 300 ft. at 1 Violet Thomas in 3-U-79 about seven miles south of Grayson, the county seat. Operators reported top of the Mississippian Big lime at 289 ft.

In Estill County 21-P-68 Raydure Corp. lost hole at their 1 Omar Shouse deep test of the Ordovician St. Peter formation. Collapsed casing caused operators to skid rig after having drilled to a total depth of about 1,375 ft. or roughly half way to their objective formation.

CALIFORNIA

Union Completes Tejon Flats Wildcat

Union Oil Co. has completed its wildcat in the Tejon area of southeast San Joaquin Valley for a small oil producer in the Tecuya sand, Oligocene age, at 6,912-19 ft. On a 16½-hour test the wildcat, 46-23 Reserve-Kerr, flowed 83 bbl. of 29°-gravity crude through a 24/64-in. choke.

Located in SE NE SW 24-11n-19w, about 2 miles northeast of the shallower Tejon Ranch field, the wildcat was started as an Eocene test. It is believed that basement was encountered after drilling through the Oligocene rocks, that the Eocene is missing as is the case at Tejon Hills 2½ miles eastward.

About 3 miles southwest, in Section 32, Standard Oil Co. of California 35 C.C.M.O. halted drilling at 2,721 ft. to set 13⅜-in. casing. The wildcat is scheduled to drill to the Eocene, anticipated at about 13,000 ft.

Some 6 miles southwest and 5 miles south of Wheeler Ridge, Richfield Oil Corp. was grading location for a new Eocene wildcat. It will be 2 San Emidio-C, in 22-10n-20w, about 1 mile northeast of 1 San Emidio abandoned earlier this year.

Possible Deeper Pay at Cymric

At the old Cymric field on the west side of San Joaquin Valley, Superior Oil Co. 1 Cymric unit may have uncovered a deeper pay. On a formation test at 6,490-6,530 ft., 4,442 ft. of gassy, muddy oil was recovered.

Following the test, however, drilling was resumed toward the scheduled depth of about 10,000 ft. Established production at Cymric is from 1,500 ft. to about 5,200 ft., the deeper pays being in the Eocene.

South Tapo Holds Considerable Promise

While yet to be proved, Terry Drilling Co.'s February discovery at South Tapo Canyon in Ventura County could be of considerable importance, approaching Oakridge insofar as areal extent is concerned. The latter, about 2 miles northwest, was discovered last August, and already has 20 producers on a proved area of more than 300 acres. Thickness of the Luisian sand pay in the discovery well at South Tapo was substantially below that in the Oakridge wells, however. Union Oil Co. was in process of completing a two-location north extension to the 2 Tapo discovery, finaled at 2,370-2,507 ft. for flowing production of 700 bbl. of 35°-gravity crude daily.

In San Joaquin Valley exploration was highlighted by the starting of several new Eocene tests on the southern edge of the Valley. At the end of February an even dozen tests were under way or being pre-

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***Address inquiries to* Frank W. Campbell,**
The DoALL Company, Des Plaines, Illinois
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pared, most of which were scheduled to drill to 13,000 ft. or deeper.

Tapo Canyon Pool Extended

A north offset to Terry Drilling Co.'s recent shallow discovery at South Tapo Canyon, Ventura County, was completed as a 700-bbl. producer of 32°-gravity crude. The extensioner, Union Oil Co. 1-12 Simi, topped the Terry sand at 2,394 ft. Production was through perforations at 2,394-2,503 ft. Union 2-12 Simi was under way as an east offset, in SE SE 12-3n-18w.

Los Angeles Discovery Completed

Hathaway Co. completed its wildcat 1½ miles southeast of Santa Fe Springs as a 250-bbl. producer through perforations at 8,486-8,686 ft. The discovery, 1 Woodward in SE NE 11-3s-11w, is about ⅞ mile east of a small well The Texas Co. completed four months ago in upper Miocene sand stringers at 8,765-8,935 ft.

OKLAHOMA

Panhandle Report

The Oklahoma Corporation Commission has recently approved an order granting approval of 640-acre gas development in a 42-section area of Cimarron County's Keyes District in the Oklahoma Panhandle.

Gas deliveries will be increased to about 30,000 M.c.f. daily, an increase of 10,000 M.c.f. daily. The Keyes sand is producing at four wells in the spaced area currently. Ultimate recovery is estimated at 3.83 billion cu. ft. of natural gas per 640-acre unit.

New Gas Discovery

Cities Service Oil Co. has a new gas strike at 1 Whisennand, NE NE SW 2-5n-9eCM, southeast of new North Sturgis pool, Cimarron County. The discovery well is rated at 5,200 M.c.f. of gas per day from perforations at 4,640-58 ft. in the Keyes sand.

In Texas County, on the east side of Hugoton field, a wildcat is being tested in the Permian, The Texas Co. and Skelly Oil Co. 1 Goosen, C NW NW 29-4n-19eCM, 7 miles west of Dombey, Oklahoma. Total depth is 6,800 ft. with the well plugged back to 2,740 ft.

Beaver County reports two disappointing failures, one in the Light-Greenough area, the other northwest of Forgan. J. M. Huber Corp. et al's 1 Sharp "A," C NE NW 18-6n-22eCM, is dry at total depth of 6,400 ft. in the Chester lime. Northwest of Forgan Columbian Fuel Corp.'s 1 Adams, C SW NW 16-6n-23eCM, is dry at 6,700 ft.

New Skinner Discovery

Noble County, north central Oklahoma, has a new Skinner sand discovery at D & L Oil Co.'s 1 Curby, 4 miles east of Billings.

The pool opener is located in the SW SW NE 26-24n-2w, and production is from the Skinner sand perforations at 4,255-68 ft., flowing 67 bbl. per hour through casing and is shut in.

Elsewhere in Noble County Newt Barrett, Grady Musgrave, and Midwest Oil Corp. are testing a new pay indication for North Orlando pool at 1 Steiner, SE SW SW 19-20n-1w. A drill-stem test from 4,732-48 ft. in the Skinner gave up 390 ft. of oil.

Eola Pool Expands

Garvin County's Eola pool in central southern Oklahoma has a new west extension and promise of two new Hunton limestone discoveries to the east of the field.

Stanolind Oil & Gas Co.'s 1 McKey, SE NE SW 12-1n-3w, is the new west extension, flowing gas at the estimated rate of 12,500 M.c.f. per day from a drill-stem test at 10,030-10,070 ft. in the McLish sand. Recovery was 200 ft. of 50°-gravity distillate.

The two new Hunton lime discoveries to the east of the field are Sohio Petroleum Co.'s 1 Freeman, SW SE 7-1n-2w, which flowed 210 bbl. of new oil in 16 hours from Hunton perforations at 6,258-90 ft., and 2 Harrell, SE SE NW 7-1n-2w, which flowed at the rate of 409 bbl. of oil daily from the Hunton at 7,236-80 ft. The 2 Harrell also flowed 225 bbl. of new oil in 21 hours from the McLish perforations at 9,173-97 and 9,203-30 ft. with testing continuing.

Northwest Kendrick Field Expands at Fast Pace

Central Lincoln County's Northwest Kendrick pool has two new completions and three new tests that are bringing considerable promise to this new field which was opened last January.

The pool opener was W. A. Barton's 1 Hartwell, SW SW NW Section 5-75n-5e. The discovery well flowed 180 bbl. of oil per day from the Prue sand at 3,525-3,557 ft.

The discovery well has been offset to the west on the northwest flank of the field by the completion of Ditsworth & Newlin's 1

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Naylor, SE SE NE 6-15n-5e, which was completed flowing 150 bbl. of oil per day from the Prue sand through open hole at 3,528-3,552 ft. Floyd G. Hubbell completed 1 Gumaer, NE NE NE Section 7, on the south flank of the new pool flowing 408 bbl. of oil per day through open tubing from open hole at 3,523-3,550 ft., also in the Prue sand. Three other wells are drilling in the area that has five producing wells.

Oil String Set at New Oklahoma Discovery

Oil string is being set at the new northwest Edmond area discovery, Huffman & Malloy et al 1 Salisbury, SW SE NE 13-14n-4w. The gas-distillate discovery is located 5 miles northwest of Edmond. The best test reported at the well was from 6,630-67 ft. when gas flowed in 4 minutes at the estimated rate of 15,000 to 20,000 M.c.f. per day with a spray of oil or distillate. Recovery on the test was 200 ft. of distillate and 50 ft. of drilling water.

Drilling Picks Up in Pontotoc County Area

Pontotoc County in lower east central Oklahoma has seen an active exploration and development program in recent weeks.

Consolidated Petroleum Industries recently finaled a good Calvin sand producer and has staked three new locations in the new area just off the east flank of Southwest Konawa field. The 1 Dye, SE SE NW 2-5n-5w, is on the pump at 68 bbl. of oil per day, which is allowable. The well gave up 175 bbl. of oil on a swab potential from the Calvin sand perforations at 1,784-2,070 ft.

The Conservation area of Pontotoc County, which has had increased development recently, had a good completion at Don Clawson 5-A Floyd, SE SE SW 34-5n-6e. The well flowed 65 bbl. of oil per day from the Senora sand at 1,496-1,503 ft.

A Hunton lime discovery was indicated recently at Lee Evans, Shawver & Hailey 1 Myers, SE NE SW 15-5n-6e, Pontotoc wildcat. The well flowed 12 bbl. of oil per hour after acid from Hunton perforations at 2,822-50 ft. The well also had Thurman possibilities at about 1,700 ft. Operators are testing at the indicated discovery.

TEXAS

NORTH CENTRAL TEXAS

Nolan Wildcat Flows Pennsylvanian Oil

A new producing structure has been discovered in southeastern Nolan County at Stanolind Oil & Gas Co. 1-E TXL, 8 miles north of Blackwell, in 15-Z-T&P Survey.

Operators topped the Cisco sand at 4,095 ft. on elevation of 2,441 ft. Drill-stem test between 4,077-4,102 ft. had oil at the surface in 36 minutes, and was shut in with no estimate on the rate of flow. Recovery was oil and oil-cut mud with no water.

At 4,096-4,112 ft. the well again flowed oil, but a 1-hour test between 4,111-32 ft. recovered 70 ft. of slightly gas-cut mud. Drilling continued below 4,377 ft.

New pay in new field... Leo R. Hewitt's second well in Section 2668, TE&L Survey, 8 miles south of Bryson in Jack County, found flush production in a new horizon.

Hewitt 2 J. W. Kinder stopped at 4,220 ft., in Caddo pay topped at 3,900 ft. Completion potential was 599 bbl. of 43° oil a day through ½-in. choke. Hewitt 1 Kinder, south of No. 2, flowed 420 bbl. daily from its discovery pay in the Marble Falls limestone.

Grayson County... Seitz, Comegys & Seitz 2 W. P. MacKey, John Bridges Survey, had prospects of a new and deeper pay section in the Mackey-Strawn pool 3 miles southeast of Whitesboro.

A 1-hour drill-stem test from 5,113-23 ft. recovered 750 ft. of oil and 18 ft. of oil and gas-cut mud. Other zones indicating pay were from 4,480-89 ft. which developed 4,007 ft. of oil in 1 hour; from 4,541-50 ft. which returned 2,170 ft. of oil, and at 4,752-63 ft. which recovered 1,249 ft. of oil in 1 hour. Nearest production in the field is around the 3,800-ft. level.

New work in Grayson County included a 10,000-ft. wildcat 5 miles northeast of Whitesboro. The well is Superior Oil Co. 1-A Weldon Cooper, J. Alameda Survey, A-33, Howell, Holloway & Howell have staked location for 1 I. E. Vanney, 5,300-ft. wildcat 4 miles southeast of Collinsville in the W. Fisher Survey, A-416.

EAST TEXAS

New Field in Prospect Southwest of Tri-Cities

Possibilities of a new gas-distillate field southwest of the Tri-Cities field in Henderson County were seen at Pure Oil Co. et al 1 Creslenn Ranch Co. A drill-stem test at 7,415-7,510 ft., tentatively identified as the Bacon limestone, recovered 630 ft. of distillate and 60 ft. of mud cut with gas and distillate. Operators were drilling ahead on a Travis Peak contract.

Byrd Oil Corp. 1 S. A. Reynolds had shows of a new pay section in the Rodessa for the Winnsboro field of Wood County. In addition to oil shows in the Baker and Gloyd lime sections, regular pay for the field, the well indicated production at 7,907-20 ft. and operators prepared to test.

SOUTHWEST TEXAS

Brooks County Wildcat Finds Deeper Oil Pay

Another prospective producing horizon has been found by Mills Bennett in a wildcat, 1 Fee, located 12 miles southwest of Falfurrias, in Brooks County. The new indicated pay was logged at 4,682-86 ft., where a 15-minute drill-stem test got a flow of oil and recovered a full hole of 47°-gravity oil. Bottom-hole flow pressure was 1,650 to 1,675 psi. Shut-in pressure was 2,075 psi. Hole is being deepened. Oil recoveries previously have been made in drill-stem tests of intervals at 3,977-81 ft., 3,981-85 ft., and 4,432-36 ft. Location is on a 39,972-acre block in the El Tule Grant 257.

TEXAS GULF COAST

Large Gasser Completed In Chocolate Bayou Field

A substantial addition to the already large gas and distillate reserves of the Chocolate Bayou field, in Brazoria County, has been made by Phillips Petroleum Co. with the completion of another large well, its 1-L Houston.

The well had an open flow potential of 190,000 M.c.f. of gas per day, and on a 14/64-in. choke made 7,610 M.c.f. per day and high-gravity distillate at the rate of 380 bbl. per day.

Production is from a lower Frio sand, open through casing perforations at 12,051-72 ft. This sand is a comparatively new pay zone for the field. The new well is located about ⅝ mile northwest of the discovery producer, 1-S Houston.

Phillips Petroleum Co., principal operator, holds approximately 22,000 gross acres of leases in the Chocolate Bayou area. Approximately 9,000 acres of these are producing oil, gas, and distillate from 12 formations.

New Distillate Producer Extends Wadsworth Field

Production of the rapidly developing Wadsworth field, 2 miles northeast of the town of Wadsworth, in Matagorda County, has received another sizable extension with the completion by Magnolia Petroleum Co. of its 1 Hamilton Savage, flowing 217 bbl. of 49.5°-gravity condensate with 7,280 M.c.f. of gas on a 20-hour production test through 14/64-in. choke.

Tubing pressure during the test gaged 7,048 psi. Gas-oil ratio figures 28,000 cu. ft. per barrel.

Production is from a casing-perforated interval at 11,246-54 ft., which may be a new pay horizon for the area. Production of the field's discovery well, 1 Cornelius, located ⅔ mile to east, is from a perforated interval at 11,375-85 ft. Hole had been drilled to 12,005 ft.

Location has been made about ⅜ mile further southwest for another extension attempt. The new operation is 2 Savage.

ARKANSAS

New Cotton Valley Pool Opened in Union Area

A new Cotton Valley pool has been opened 1½ miles east of old Lisbon field in the central part of Union County, south Arkansas.

Don D. Montgomery's pool opener, the 1 Brasher, C SW NE 14-17s-16w, flowed 192 bbl. of oil per day from perforations at 4,941-50 ft. opposite the Cotton Valley sand.

West Midway field, recently opened in Lafayette County by McAlester Fuel Co. at 1-B McDonald, has a confirmation test drilling ahead below 4,065 ft. at Sunray Oil Corp.'s 1 Ruby, C NW NE 7-15s-24w. The well is checking about 10 ft. higher on structure than the McDonald field opener. The discovery well flowed 280 bbl. of oil per day from the Smackover lime.

APPALACHIAN AREA

OHIO

Preston Oil Co. completed a better than average producer in the north extension to New Castle pool, the 2 Stephen Sells, 2nd. Qr., New Castle Township, Coshocton County. Clinton sand at 3,142-3,198 ft. was shot with 100 qt. and flowed and swabbed 140 bbl. in 24 hours.

Waverly Oil Works 11 Cartnal Bros., 2nd Qr., Hanover Township, Licking County, found the Clinton at 2,781-2,828 ft. with a good showing of oil that increased to 120 bbl. in 24 hours after a 90-qt. shot.

Ohio Fuel Co. completed a large gasser on

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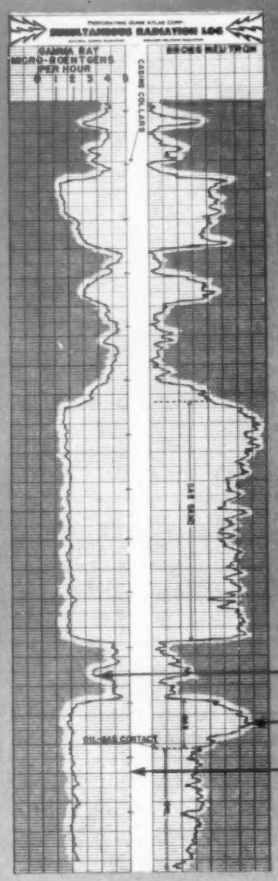

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1 Charles Crile, Lot 10, Wellington Township, Lorain County. Clinton sand at 2,30--2,322 ft. gaged 14,000,000 cu. ft. natural.

LOUISIANA

NORTH LOUISIANA

Testing Under Way at Bossier Parish Well

An indicated gas-condensate discovery is taking drill-stem tests from perforations at 8,316-8,330 ft. opposite Bodcaw sand of the Cotton Valley series. Pan American Production Co.'s 1 Hunt, Section 5-19n-13w, Bossier Parish, had indicated gas-condensate production from this interval earlier in the month. Recovery on the earlier test was 360 ft. of heavily gas-cut water cushion, 180 ft. of heavily gas-cut mud and some condensate. The prospect is located 3¾ miles northeast of Sentell field, also a Bodcaw producer.

Redland Field Confirmed With First Oil Well

Bossier Parish's new Redland field has been confirmed with the completion of the first oil well for the previously one-well gas-condensate pool.

Continental Oil Co. finaled 1 Steward, 510 ft. from south line, 1,933 ft. from east line, Section 19-23n-12w, flowing 90 bbl. of 44°-gravity oil per day from perforations at 7,377-87 ft. opposite a sand lens in the Travis Peak.

The field's discovery well was completed in 1952 for 1,338 M.c.f. of gas from 7,356-66 and 7,370-80 ft. with the gas-condensate ratio 35,300:1. The discovery well was Continental's 1 Goodwin, C SW NW 29-23n-12w. Continental is drilling 1 Keoun ½ mile east of the discovery well in 29-23n-12w.

SOUTH LOUISIANA

Lobdell Area Outpost Flows Gas-Condensate

A west outpost well in the Lobdell area of West Baton Rouge Parish has been completed as a gas-distillate producer from the 8,800-ft. sand previously productive on the opposite (east) side of the field. The field proper produces oil from a 9,300-ft. sand.

The new extension well, drilled by Humble Oil & Refining Co. as 1 Lester Seidenbach, in 2-7s-11e, flowed 3,394 M.c.f. of gas with 65.4 bbl. of 58.5°-gravity condensate per day through ¼-in. choke, gaging 3,100 psi. pressure on the tubing.

The well, drilled to 9,502 ft., tested water in the field's 9,300-ft. oil sand.

Gas-Condensate Tested In Terrebonne Wildcat

Opening of a new gas-condensate producing area, located northwest of the recently discovered Four League oil field, in Terrebonne Parish, is virtually assured by initial production tests by Shell Oil Co. at its 1 State Lease 2077, in Township 19s-12e.

The well flowed 2,944 M.c.f. of gas with 41 bbl. of condensate on a 24-hour test through 16/64-in. choke, gaging 2,785 psi. flowing pressure on the tubing. Production is from a casing-perforate interval of 7,540-49 ft. Hole had been drilled to 12,750 ft. and casing run to 11,003 ft. Plug-back depth is 7,600 ft.

The Four League field was discovered by Humble Oil & Refining Co.

WILDCAT COMPLETIONS

SOUTHWEST TEXAS

Atascosa County: Big "6" Drilling Co. 1 Nisbett, B. Littleton Survey 1610, A-1562. Dry. TD 3,766 ft.

Brooks County: Hamman Oil & Refining Co. and States Marine Corp. 1-B Boedecker et al, CCSD & RGNG Survey 9. Dry. TD 7,066 ft.

Bastrop County: James Joyner 1 Randle, J. Walters Survey. Dry. TD 3,126.

Bexar County: Buena Vista Oil Co. 1 Henze et al, Juan Montez Sur., Blk. 4007. Dry. TD 805 ft.

Duval County: O. G. McClain 1 Sutherland, SA & MG Sur. A-534. Dry. TD 3,243 ft.

The Texas Co. 2-A First National Bank of Mathis, S. Blankenship Sur. 430, A-1567. IP 5,500 M.c.f. daily, open flow, Cockfield 4,470-75 ft. TD 4,652 ft.

Frio County: Robert M. Bass 1 Sheppard, Elizabeth Poor Sur. 766, A-541. Dry. TD 1,260 ft.

Forest Oil Co. 1 Halff & Oppenheimer, Nathaniel Karr Sur. 920½, A-437. Dry. TD 4,532 ft.

J. C. McCabe 1 Jones, Hooper & Wade Sur. 1, A-393. Dry. TD 3,581 ft.

J. C. McCabe 2 Jones, Hooper & Wade Sur. 1, A-393. Dry. TD 3,215 ft.

Gonzales County: L. G. Shelly 1 Kolar, L. Tumlinson Sur., A-75. Dry. TD 2,426 ft.

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Initial wells when drilled in the Sansinena field were put on the pump and
Rotary Torque Indicator Saves Drilling Costs
Trouble had been experienced with bit cones becoming detached when drilling in West Texas. Consequently, fishing jobs were necessary with the attendant loss of drilling time and additional expense.
The cause of cones breaking off was due to the fact that a cone would lock, and by additional rotation of the bit itself the jammed cone would shear-off. More often than not any indication of what had happened down the hole was not immediately apparent. A fishing job was the result.
A torque indicator will show when a cone jams, as the driller can see at once on the gage the sudden increase in the torque reading. The bit is then pulled and a fishing job has been avoided.
One company in a West Texas area spent on an average of $10,000 per well on recovering lost bit cones before the rotary torque indicator* was included as an "eye" for the driller. Since then, the cost charge against "fishing for cones" has been zero.
*Martin-Decker Hydro-Mech torque gage.
MARTIN DECKER CORP.
LONG BEACH, CALIFORNIA

*The above information was obtained by Jack Meneer, an editorial writer for the PETROLEUM ENGINEER, who gave permission for reproduction.

WILDCAT COMPLETIONS

Hidalgo County: Fitzpatrick Drilling Co. 1-A Kronmueller estate, Alamo Land & Sugar Co., Subd. IP 116.8 BOPD, 7/32-in., 47.9°, perforations 6,061-69 ft. TD 7,007 ft. New pay in Donna field.

Jim Hogg County: Quintana Petroleum Corp. 1 Silver Lake Ranches, Inc., Sec. 11, Fowler & Rankin Subd., El Sordo Grant, A-236. Dry. TD 4,100 ft.

Jim Wells County: Southwestern Oil & Refining Co. 1 Presnall, Blk. A, Richard King Farm Lots. IP 14,000 M.c.f. daily, open flow, perforations 3,957-78 ft. TD 3,978 ft. Extends Bailey field.

McMullen County: H. L. Hawkins and R. N. Ranger 1 Hagist, H. B. Cook Sur. 5, A-165. Dry. TD 7,115 ft.

Phillips Petroleum Co. 3 Mula, GWT & T Sur. 5, A-534. Dry. TD 6,205 ft.

The Texas Co. 1 Atkinson, John R. Pace Sur. 474, A-1182. Dry. TD 8,015 ft.

Nueces County: Skelly Oil Co. 1 James, Sec. 4, Laureles Farm Tracts. Dry. TD 4,704 ft. Deep test London area.

Tri Mark Oil Co. 1 Guggenheim & Cohn, Blk. 12, Sec. VIII. Dry. TD 6,020 ft.

San Patricio County: Bridwell Oil Co. 1 Davis, Sec. 90, George H. Paul Subd. Dry. TD 5,750 ft.

Drilling & Exploration Co. 1 Murray, George Sargent Sur., A-231. Shut down 9,637 ft.

TEXAS GULF COAST

Bee County: O. Neathery, Jr. 1 Meuth, CCD Co. Sur., A-359. Dry. TD 4,807 ft.

Brazoria County: W. Stewart Boyle 1 T. L. Smith et al, Lot 37, T. L. Smith Subd., A. Darst Lge. IP 114.094 BOPD 9/64-in., 26°, perforations 4,430-46 ft. TD 4,446 ft. New pay in Damon Mound field.

Greenbrier Oil Co. 1 Bryan, J. Brougham Sur., A-164. Dry. TD 7,520 ft.

Calhoun County: Humble Oil & Refining Co. 1 State, Tract 55, Lavaca Bay. IP 4,390 M.c.f. daily and 158 BOPD, ¼-in., perforations 8,597-8,615 ft. TD 9,608 ft. Extends Killers Bay field.

The Texas Co. 1 State, Tract 16, Lavaca Bay. Dry. TD 8,980 ft.

DeWitt County: Kirkwood & Co. et al 1 Bluntzer heirs, John McCrabb Lge., A-336. Dry. TD 8,050 ft.

Goliad County: Magnolia Petroleum Co. 3 Irby, William Stewart ⅓ Lge., A-254. Dry. TD 3,782 ft.

W. C. McBride, Inc., 1 Von Dohlen, John White Sur., A-288. Dry. TD 5,640 ft.

Harris County: Jack W. Frazier et al 1 Biggers, Sec. 29, John Cunningham Lge., A-193. Dry. TD 8,317 ft.

R. E. Hibbert 1 Bauer, Blk. 1, WCRR Sur. 13, A-915. Dry. TD 8,210 ft.

H. R. Smith 2 Locke unit, Reels & Trobough Sur., A-59. IP 120 BOPD, 8/64-in., 30.5°, Frio perforations 5,755½-59½ ft. TD 7,000 ft. New pay in Clinton field.

Jackson County: Petrex Oil Corp. 1 Houston heirs, V. Garcia Sur., A-24. Dry. TD 6,730 ft.

Progress Petroleum Co. of Texas 1 Weaver, Hugh McGuffin Sur., A-43. Dry. TD 9,013 ft.

Jasper County: American Republics Corp. and Houston Oil Co. of Texas 1 Johnson fee, John D. Johnson Sur., A-21. IP 38.1 BOPD, 9/64-in., 46.2°, perforations 7,572-79 ft. TD 8,132 ft. New pay in North Buna field.

Jefferson County: So Relle & So Relle 1 Ward, T&NO Survey, A-268. Dry. TD 9,441 ft.

Karnes County: Forney & Winn and William McBride Love 1 Kunkel, Don Erasmo Sequin Survey. Dry. TD 4,031 ft.

Kirkpatrick & Coates 1 Zint, W. Hunter Survey, A-137. Dry. TD 6,367 ft.

Liberty County: Eddy Refining Co. 1 Humphreys et al, Franklin Hardin Survey. IP 2,000 M.c.f. daily and 40 BCPD 1.0/64-in., 49.8°, perforations 8,419-24 ft., 8,428-35 ft., and 8,441-48 ft. TD 8,510 ft.

Sohio Petroleum Co. 1 Foster, T. S. Foster Survey 158, A-929. IP 46,000 M.c.f. daily, open flow, Cockfield perforations 6,230-45 ft. TD 7,392 ft. New pay in Quinn field.

Live Oak County: Buzzini Drilling Co. 1 Cheatam, AB&M Survey 101, A-66. Dry. TD 7,520 ft.

Pontiac Refining Co. 1 Prowse, R. Houlihan Survey 45, A-540. Dry. TD 4,964 ft.

Renwar Oil Corp. 1 Shipp, P. Salinas Survey, A-418. Dry. TD 5,005 ft.

Matagorda County: Skelly Oil Co. 1 Silver Lake, John Duncan & T. J. Williams Survey. Dry. TD 9,100 ft.

Refugio County: Austral Oil Exploration Co. and Phillips Petroleum Co. 1 Rooke, Adrete Survey, A-1-2-3. Dry. TD 8,529 ft.

San Jacinto County: C. C. Gilger and Drilling & Exploration Co. 1 Beazley, J. D. Martinez Survey, A-34. IP 2,750 M.c.f. daily, open, Wilcox perforations 7,791-7,804 ft. TD 8,003 ft. Extends Ace New field.

Victoria County: Alaska Steamship Co. 1 Wedemeier, A. Cruz Survey, A-153. Dry. TD 4,991 ft.

Harry Bass Drilling Co. 1-A Selina Mernitz

U. S. POOL MAPS

Here are 16 maps of the most active oil areas in the United States. Shows both oil and gas pools.

These maps are lithographed in three colors and give locations and names of both oil and gas fields.

Small scale—Journal page size—they are convenient for ready reference in field or office. Survey lines make easy plotting of new wildcat locations.

Areas Covered: 1) California, 2) Intermontane Basins, 3) Northern Wyoming, 4) Williston Basin, 5) Kansas, 6) Julesburg Basin, 7) Hugoton Area, 8) Oklahoma, 9) North and East Texas, 10) Permian Basin, 11) West Gulf Coast, 12) South Texas, 13) East Gulf Coast, 14) Miss.-La.-Ark., 15) Tri-State Area, 16) Michigan.

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WILDCAT COMPLETIONS

et al, Edward Linn Survey, A-79. Dry. TD 9,513 ft.

Wharton County: Harry Todd 1 Kelley estate, GC&SF Survey, A-857. Dry. TD 5,220 ft.

EAST TEXAS

Henderson County: E. B. Germany & Sons 1 Ansley, J. Hallmark Sur. Dry. TD 1,000 ft. Core test.

E. B. Germany 1 Bruce Smith, A. Carroll Sur. Dry. TD 830 ft. Core test.

Murray Petroleum Co. 1 Cook Ranch, M. A. Knox Sur. Dry. TD 4,510 ft., Georgetown 4,350 ft.

Hopkins County: B. G. Byars 1 C. C. Formby, Levi Landers Sur., A-548. Dry. TD 4,470 ft.

Hunt County: Dilworth S. Hager 1 O. T. Ward, James Cole Sur., A-152. Dry. TD 3,407 ft. in Woodbine sand.

*Limestone County: Cities Service Oil Co. 1 Dorothy Bounds, Sarah McNulty Sur., 2½ mi. SW Wortham. IP 13,000 M.c.f. gas, 39 bbl. distillate, Woodbine 4,217-36 ft., elev. 479 ft., TD 5,954 ft.

WEST CENTRAL TEXAS

Callahan County: Rex-Ray Drilling Co. 1 Ernest Windham, Sec. 245, C. Cole Sur. Dry. TD 4,253 ft., elev. 1,729 ft., Ellenburger 4,200 ft.

Coleman County: A. L. Andree 1 J. W. Hunter, Jr., Sec. 74, D. Frazier Sur. Dry. TD 2,354 ft.

Duncan Drilling Co. 1 Baines, 15-2-SPRR. Dry. TD 3,915 ft., elev. 2,044 ft., Gray 3,867 ft.

*Miami Operating Co. 1 A. C. Atchley, 13-2-T&NO. IP 122.5 BOPD, 13/64-in., 41°, pay 3,729-32 ft. TD 3,756 ft.

*Mid-Continent Petroleum Corp. 1 J. N. DePrang, Sec. 9, Brooks & Burleson Sur. IP 120 BOPD, 17/64-in., 40°, pay 3,838 ft. TD 3,851 ft.

*French M. Robertson and F. Kirk Johnson 1 Robertson, 6-519-San Augustine University Lands Sur. IP 160 BOPD, 20/64-in., 42°, pay 3,888-3,905 ft. TD 3,940 ft.

Horace White 1 T. N. Evans, 657-12-H. Cochran Sur. Dry. TD 1,830 ft.

Eastland County: Don H. Peaker 1 Viola Cesario, 39-4-H&TC. Dry. TD 1,712 ft.

*Haskell County: Thos. D. Humphrey & Sons 4-A McGregor, Blk. 63, W. Wadsworth Sur., A-425. IPP 86.8 BOPD, 37°, sand pay 2,525-35 ft. TD 2,535 ft.

Sojourner Drilling Co. 1 M. Jones, 21-1-H&TC. Dry. TD 5,081 ft.

*Jones County: Belcher-Harding 1 D. F. Bond, Sec. 204 J. W. McKissick Sur. IP 192 BOPD, 16/64-in., 42°, pay 4,550-60 ft. TD 4,604 ft.

Sid Katz 1 E. T. Pittard, 49-1-BBB&C. Dry. TD 3,047 ft.

Sid Katz 1 O. Thomas, 63-1-BBB&C. Dry. TD 3,250 ft.

Nolan County: J. C. Barnes 1 Aycock, 58-21-R&P. Dry. TD 6,257 ft.

*Shackelford County: C. B. Christie 2 T. G. Hendrick, Sec. 160, ETRR Sur. IPP 17 BOPD, pay 1,316 ft. TD 1,350 ft.

G. E. Fagg 1 L. G. Davis, 44-13-T&P. Dry. TD 1,825 ft.

Landa Oil Co. 1 Hollis Manly, 41-14-T&P. Dry. TD 1,904 ft.

Stonewall County: General Crude Co. 2 Pauline Ybarra, 175-1-H&TC. Dry. TD 6,042 ft., elev. 1,832 ft., Caddo 5,988 ft.

Taylor County: Robinson-Puckett, Inc., 1 Vester Parrish, 118-64-H&TC. Dry. TD 5,470 ft.

*Throckmorton County: Noel Pautsky and Britton Bros. 1 Hail, 3047-A769-TE&L. IP 125 BOPD, ¼-in., 42°, pay 4,226-34 ft. TD 4,234 ft.

NORTH TEXAS

Archer County: Petrex Oil Corp. 1 Wilson Blk. 67 Fee, Blk. 67, ATNCL. Dry. TD 4,569 ft.

Lewis W. Welch 2 G. A. Key, Sec. 27, A-647, J. Taylor Sur. 24. Dry. TD 5,146 ft., elev. 1,054 ft., Caddo 4,650 ft., Mississippian 5,121 ft.

Cottle County: Gulf Oil Corp. 1 D. C. Shamburger, Sec. 5, F. P. Knott Sur. Dry. TD 7,051 ft.

Denton County: James Papadakis 2 Holland, J. C. P. Melton Sur., A-802. Dry. TD 2,876 ft.

Grayson County: C. J. Simpson Drilling Co. 1 J. S. Brown, HT&B Sur., A-607. Dry. TD 5,699 ft.

*Jack County: Ada Oil Co. 1 E. E. Ellis, J. L. Duerson Sur., A-2192. IP 189 BOPD, 12/64-in., 42°, conglomerate 5,222-30 ft. TD 5,730 ft.

*Brown Drilling Co. 1 W. Hickman, T. M. League Sur., A-348. IPP 51 BAPD, 40°, sand pay 2,975-85, 3,018-30 ft. TD 3,105 ft.

McMahon-Bullington 1 W. L. Brumbelow, G. W. Davis Sur., A-179-80. Dry. TD 5,880 ft.

Neeld & Hood Drilling Co. 1 S. E. Maxey, SPRR Sur., A-568. Dry. TD 4,626 ft., Caddo 4,513 ft.

Smith Contracting Corp. 1 L. B. Skaggs, SA&MG Sur. Dry. TD 1,004 ft.

*Warren Petroleum Corp. 2 Cap Yates, J. Rutherford Sur., 4-142. IP 80 BOPD, 32/64-in., conglomerate 5,388-5,400 ft. 1 mile NE of production.

*Knox County: Thos. D. Humphrey & Sons 3 Mary A. Bush, E. Brown Sur. 51,

This is under no circumstances to be construed as an offering of these securities for sale, or as an offer to buy, or as a solicitation of an offer to buy, any of such securities. The offer is made only by means of the Prospectus.

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Smith, Barney & Co.

March 18, 1953

A-831. IPP 113 BOPD, Strawn 4,964-70 ft. TD 5,955 ft.

Montague County: Ada Oil Co. 1 H. Husfeld, Blk. 70, Hill CSL. Dry. TD 5,765 ft.

H. O. Grace 1 Everett Heirs, W. B. Lloyd Sur., A-435. Dry. TD 6,508 ft., Caddo 5,893 ft.

Wichita County: Cox Drilling Co. 2 Kemp & Kemper, Blk. 82, Kemp WVFL Burton Subd. Dry. TD 1,882 ft.

J. E. Gray Drilling Co. 1 Emma Schulz, James Cole Sur., A-37. Dry. TD 2,005 ft.

WEST TEXAS

Andrews County: Western Drilling Co. and Tobe Foster 1 J. T. Lindley, 16-A47-PSL. Dry. TD 4,499 ft.

Concho County: Holland Oil Co. 1 Samson Land & Cattle Co., L. Sterling Sur. 328, A-715. Dry. TD 1,408 ft.

* Crockett County Cities Service Oil Co. 1-B Hobbs, 7-GG-GC&SF. IP 12,500 M.c.f. gas, Cisco 5,912-30 ft. TD 5,984 ft.

* Houston Oil Co. 1 Margaret Shannon, Richard Pillow Sur. 1. IP 82.5 BOPD, 35°, Pennsylvanian 6,608-18, 6,624-48 ft. TD 8,189 ft.

Ralph Lowe 1 Maggie S. Neal, 6-10-GC&SF. Dry. TD 10,012 ft., elev. 2,548 ft., Silurian 9,080 ft., Fusselman 9,450 ft., Ellenburger 9,808 ft.

Crockett County: U. S. Smelting, Refining & Mining Co. 1 F. R. Henderson, 69-OP-GC&SF. Dry. TD 8,513 ft., elev. 2,587 ft., Strawn 7,933 ft., Ellenburger 8,064 ft.

Dawson County: Cyprus Mins and Union Oil Co. 1 J. O. Goodson, 44-33-T&P. Dry. TD 8,530 ft., elev. 2,878 ft., Spraberry 6,567 ft., reef 8,498 ft.

Loving County: McDaniel & Beecherl 1-K TXL, 5-55-T1-T&P. Dry. TD 3,714 ft.

Martin County: J. I. O'Neill and Zephyr Oil Co. 1 Mabee, 12-39-T1N-G&MMB&A. Dry. TD 4,785 ft.

Mitchell County: A. W. Cherry 1 Dunn, 65-20-Lavaca Navigation Co. Sur. Dry. TD 3,103 ft.

Davidson Drilling Co. 1-A Coleman, Sec. 9, Cuthbert Strip Sur. Dry. TD 4,177 ft.

Presidio County: Lewis Welch 1 Brite, 34-4-H&TC. Dry. TD 6,133 ft.

Runnels County: Vincent & Welch 1 Myrtle Taylor, Austin & Williams Sur. 26. Dry. TD 5,106 ft., elev. 1,823 ft., Ellenburger 4,490 ft.

Twin Oil Corp. 2 J. W. Barr, R. M. Williamson Sur. 231. Dry. TD 2,500 ft.

Sterling County: McElroy Ranch Co. 1 C. H. Sugg, 53-2-T&P. Dry. TD 5,388 ft., elev. 2,562 ft., Spraberry 5,200 ft.

Terrell County: Fred Turner, Jr. 2 H. C. Noelke, 50-B2-GCSG&RGNG. Dry. TD 2,808 ft.

Tom Green County: Humble Oil & Refining Co. 2 Isaac Funk, 11-5-H&TC. Dry. TD 1,049 ft.

La Gloria Corp. et al 1 Joe H. Halfman, 153-11-SPRR. Dry. TD 4,677 ft., elev. 1,971 ft., Strawn 4,574 ft.

Mayfair Minerals, Inc. 1 Mary A. Pruett, C. S. Jackson Sur. 1823. Dry. TD 6,510 ft., elev. 2,112 ft., Strawn 4,828 ft., Ellenburger 6,360 ft.

John Odstricil 1 Groves, Sur. 2, GC&SF. Dry. TD 2,744 ft.

* Upton County: Brown & Thorp et al 1 Robbins, 6-B-GC&SF. IPP 24 BOPD, 26°, pay 2,180 ft., TD 2,261 ft.

Sinclair Oil & Gas Co. 1 J. L. Nutt, 12-B2-GC&SF. Dry. TD 6,315 ft.

SOUTHEAST NEW MEXICO

Eddy County: Stanley L. Jones 7 Continental State, 7-19s-289e. Dry. TD 2,832 ft.

Thomas M. Mayfield 1 State, 32-20s-28e. Dry. TD 400 ft.

ILLINOIS

Edwards County: Paco Petroleum Co. 1 V. & F. Woods Commission, SW NW SW 18-2s-10e. Dry. TD 3,482 ft., Rosiclaire 3,379 ft.

Fayette County: Mohawk Drilling Co. 1 Rejakoric, SW SE NE 26-7n-1w. Dry. TD 3,006 ft., Silurian 2,961 ft.

Madison County: Kirk Drilling Co. 1-A Boyle, SE NE SE 17-5n-5w. Dry. TD 615 ft.

Montgomery County: E. L. Wirth 1 Jones, SE SE NW 36-11n-5w. Dry. TD 2,508 ft., Trenton 2,386 ft.

Randolph County: Rock Hill Oil Co. 1 Miller, NE NW NE 2-4s-5w. Dry. TD 2,375 ft., Silurian 2,310 ft.

INDIANA

Daviess County: C. E. Seneff 1 Wilson, Loc. 87-3n-7w. Dry. TD 1,707 ft.

Gibson County: Benedum & Trees 1 Erdell, SW SW SE 21-2s-9w. Dry. TD 1,885 ft., Barlow lime 1,469 ft.

Sullivan County: Reed & Able 1 Gordon, NE SW NE 27-9n-8w. Dry. TD 1,141 ft.

J. Unger 1 Knotts, SE SE SE 8-6n-9w. Dry. TD 1,260 ft.

Vigo County: Bayer Petroleum Co. 1 Bell, NW NW NE 15-11n-10w. Dry. TD 2,004 ft., Devonian 1,957 ft.

KENTUCKY

Daviess County: George Hoffman 1 Cheaney, NE SW SW 22-Q-27. Dry. TD 1,980 ft., McClosky 1,906 ft.

Henderson County: Ashland Oil & Refining

WILDCAT COMPLETIONS

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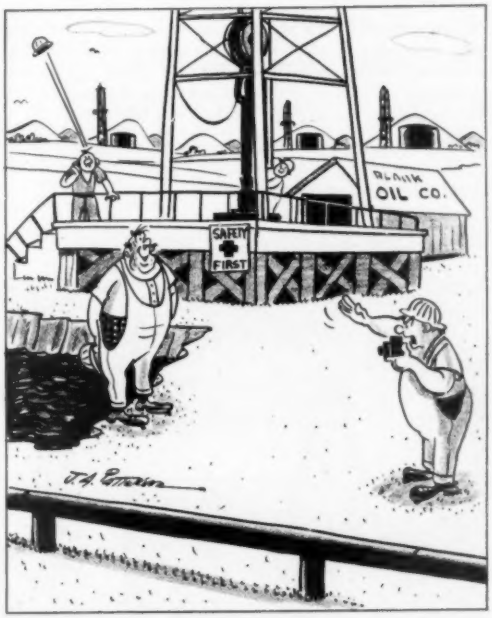
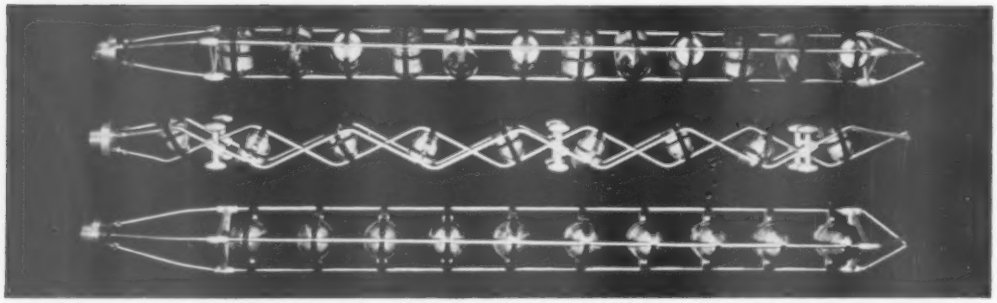


THE OIL AND GAS JOURNAL

"You better back up another step, Manley."

DOWELL GLASS GUN—



Shown above are three types of Dowell Glass Guns: horizontal-firing (top); angle-jet (center); mono-directional (bottom).

DOWELL Perfojet can be combined with these other Electric Pilot services

SELECTIVE ACIDIZING—Pilot is used to direct acid into selected zones to get best treatment results. As many as *three separate* zones can be acidized selectively in *one operation.*

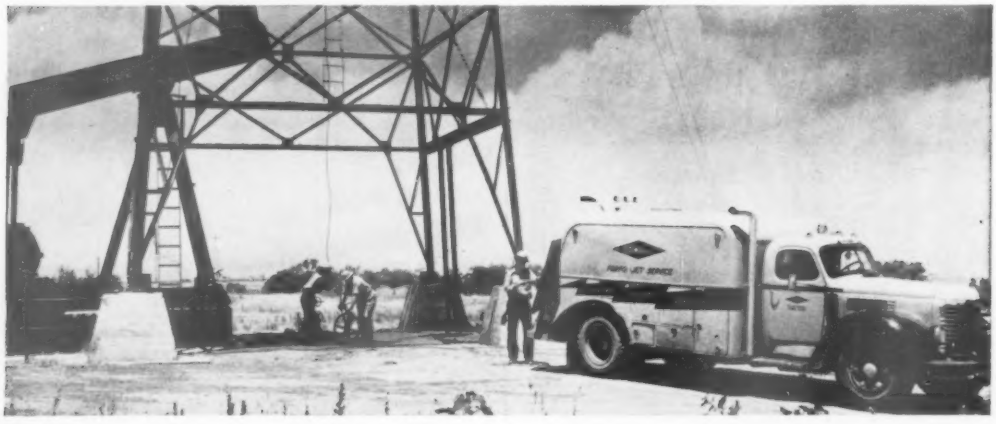
PERMEABILITY SURVEYS—Pilot is used to show location of permeable zones and their capacity to take fluid in relation to other zones, especially as a guide to selective acidizing. Also used to locate leaks around casing shoes, leaks around cement plugs and holes in casing.

SPINNER SURVEYS—Pilot is used to measure relative production or injection capacity of zones exposed in all types of producing or input wells.

WATER LOCATION—Pilot is used to locate points of water entry into wells, contributing to successful completion and workover programs. The latest water location method uses a photoelectric cell and opaque dye.

CALIPER SURVEYS—Pilot is used to give information on well bore diameters and irregularities. The caliper automatically records diameters as large as three feet and shows variations as small as casing collars—a fractional part of an inch!

THE ELECTRIC PILOT is also used for Radio-active Surveys, Temperature Surveys, Hot Wire Lost Circulation Surveys, wire-line bridge plugs and production packers.



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The expendable Glass Gun, developed by Dowell, uses the shaped charge to provide more effective well perforating than ever before. The large amounts of explosive used and the design of the charges, give deeper penetration and bigger hole size.

The Glass Gun consists of shaped charges held in a carrier made of ⅛ inch aluminum tubing. Each charge is sealed in two fluid-tight glass hemispheres and positioned in the carrier according to the desired "shooting" pattern. Glass Gun charges have withstood 10,000 psi pressure without collapsing or leaking.

These charges are detonated by Primacord, an explosive cord contained in the aluminum tubes. When the charges are fired, high velocity jets of gas are formed. These jets can penetrate more than seven inches into mild steel. At the same time, the glass containers and the carrier are disintegrated by the explosion, leaving a junk-free hole.

Dowell Glass Guns can be assembled to fit almost any well, with carrier sizes ranging from as small as 3⅝ inches up to 3 feet or more in diameter.

Among the Glass Guns offered by Dowell are the following types designed to meet various formation characteristics: the *horizontal-firing* gun for deep, level penetration . . . the *angle-jet* gun that shoots upward at an angle of 30° from the horizontal to penetrate shale streaks . . . the *mono-directional* gun which fires all its charges in the same direction for vertical-plane fracturing.

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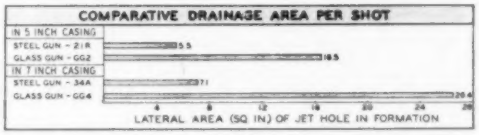
DOWELL

PERFOJET PERFORMANCE DATA

COMPARATIVE PENETRATION IN CASING PERFORATING

CASING SIZE	GUN SIZE	TYPE CHARGE	APPR. PERF DIAMETER	INCHES PENETRATION IN FORMATION
● USING STEEL GUN IN CASING				
5"	3⅜"	10R	½"	8.6
5"	3⅜"	21R	½"	8.1
5½"	4"	21R	½"	7.7
7"	5"	34A	½"	7.5
5 IN 7"	3⅜"	21R	½"	5.7
● USING GLASS GUN IN CASING				
5½"	4⅜"	GG2	½"	14
7"	4⅜"	GG4	½"	15
5 IN 7"	3⅜"	GG2	½"	11.5

COMPARATIVE DRAINAGE AREA PER SHOT



PENETRATION IN OPEN HOLE SHOOTING WITH GLASS GUN

OPEN HOLE SIZE	GUN SIZE	TYPE CHARGE	INCHES PENETRATION IN FORMATION
6"	4⅜"	GG4	19
6"	5½"	GG7	19

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FOR OIL INDUSTRY CHEMICAL SERVICE

WILDCAT COMPLETIONS

Co. 1 Konsler, SW SW NW 8-O-23. Dry. TD 2,701 ft., St. Genevieve 2,517 ft.

Ohio County: Harry Bean 1 Hatler, SW SW SE 13-L-34. Dry. TD 1,230 ft., McClosky 1,095 ft.

Union County: F. W. Meyer, Jr. 1 Mills, SW NW NW 2-O-19. Dry. TD 2,774 ft., St. Genevieve 2,582 ft.

MICHIGAN

Bay County: Raymond V. Miller 1 Boeing et al, SW SW SE 24-18n-3e. Dry. TD 3,066 ft. in Dundee.

Kent County: Sun Oil Co. 1 Brown, NE NE NW 7-8n-12w. Dry. TD 2,782 ft. in Detroit River.

Oceana County: Ford Oil Co. 1 Munford, SE SE NW 20-14n-15w. Dry. TD 2,240 ft. in Traverse.

St. Clair County: C. F. Parkinson 1 Stephenson, NE 18-5n-17e. Dry. TD 2,667 ft. in Niagaran.

ALABAMA

Pike County: F. R. Jackson 1 T. E. Jackson, C SE SW 27-8n-19e. Dry. TD 6,744 ft. Elev. 328 ft., Eutaw 960 ft., Tuscaloosa 2,054 ft., lower Cretaceous 2,735 ft.

MISSISSIPPI

Amite County: James P. Evans, Jr. 1 McAllister, C NW SE 27-2n-2e. Dry. TD 8,510 ft. Elev. 291 ft., Vicksburg 3,910 ft. Moodys Branch 4,213 ft., Cook Mountain 4,460 ft., Sparta 4,729 ft., Wilcox 5,616 ft., base Baker shale 7,418 ft.

Chickasaw County: Carter Oil Co. 1 Clem Baskin heims, C NE NW 19-14s-5e. IP 3,070 M.c.f. gas daily and 21 BC in 19 hours, 19/64-in., 53.7°, Carter sand (Mississippian Chester) 4,300-60 ft. TD 5,187 ft. in Iowa. Elev. 320 ft., Mississippian 1,325 ft., Millerella 4,157 ft., Lewis sand 5,028 ft. Iowa 5,123 ft. New field.

Forrest County: The Texas Co. 1 Gilliam et al, W½ SE NE SE 34-3n-13w. Dry. TD 11,332 ft. Elev. 357 ft., Wilcox 2,488 ft., Midway 4,873 ft., Austin 6,661 ft., Tuscaloosa 7,304 ft., lower Cretaceous 8,900 ft.

Hinds County: D. P. L. Co., Inc., 1 Gaddis & McLaurin, NW NE NE SE 8-7n-2w. Dry. TD 7,513 ft. in Tuscaloosa. Elev. 247 ft., Cook Mountain 1,040 ft., Wilcox 2,512 ft., Gas Rock 4,826 ft., Eutaw 6,730 ft., Tuscaloosa 7,435 ft.

SOUTH LOUISIANA

Plaquemines Parish: Richardson & Bass 1 State, Lease 1891, 29-20s-26e. Dry. TD 14,775 ft.

Rapides Parish: J. R. Butler 1 Freeman et al, 2-1n-1w. Dry. TD 10,015 ft.

St. Charles Parish: The California Co. 2 U.S.A., 46-12s-8e. IP 52 BOPD, 8/64-in., 34°, perforations 9,236-45 ft. TD 9,640 ft. New pay in Norco field.

Pan American Gas Co. 1 L. B. Simoneaux, 17-14s-21e. IP 420 BOPD, 12/64-in., 38.8°, Miocene 10,325-338 ft. TD 11,234 ft. New field.

St. Landry Parish: Stanolind Oil & Gas Co. 1 St. Landry Parish School Board, 16-6s-6e, 2½ miles east of Port Barre. IP 321 BOPD and 2,880 M.c.f. gas daily, 12/64-in., 46.2°, perforations 12,269-290 ft. TD 13,659 ft. New field.

Vermilion Parish: Johnny Clingingsmith and A. Delcambre, Jr., 1 LeBlanc, 49-13s-4e. Dry. TD 3,513 ft.

West Baton Rouge Parish: Circle Drilling Co. and C. B. Pennington 1 The Oaks, Inc., 93-7s-12e. Dry. TD 10,002 ft.

NORTH LOUISIANA

Bossier Parish: Glasscock Drilling Co. and Norton 1 Marston, C S½ SW SW 25-15n-11w. Dry. TD 5,204 ft.

Catahoula Parish: N. B. Hunt et al 1 Louisiana Central Mineral Co., C SW NE 33-10n-7e. Dry. TD 5,200 ft.

Winn Parish: Delta Drilling Co. et al 1 Southern Advance Bag & Paper Co., C NE NE 36-13n-3w. Dry. TD 9,660 ft. Hosston 9,412 ft.

ARKANSAS

Ashley County: Lion Oil Co. 1 Horseshoe, 50 ft. N C SW SE SW 30-17s-4w. Dry. TD 3,512 ft. Cotton Valley 3,044 ft.

Lafayette County: The California Co. 1 Foster, 9-15s-25w. Dry. TD 7,303 ft.

OKLAHOMA

Beaver County: Columbian Fuel Corp. 1 Adams "L," C SW NW 16-6n-23eCM. Dry. TD 6,701 ft.

* Garfield County: Geo. Deck et al 1 Dyer, SW NW SE 5-23n-4w. IPF 74 BOPD, Mississippi lime 5,482-5,504 ft., 67°, 432 BOPD, Marshall 6,112-27 ft., 43.2°, TD 6,250 ft. (New pay at Northeast Prairie Valley pool, the Marshall [Simpson series]).

Kay County: G. O. Harwell 1 Nelson, NW NW NE 15-27n-1e. Dry. TD 4,192 ft.

Helmerich & Payne 1 Whitmore, SW SW NW 14-27n-2e. Dry. TD 4,005 ft.

Trans-Era Petroleum, Inc. 1 De Buhur, NE NE NW 7-28n-2w. Dry. TD 4,834 ft.

Lincoln County: Sam A. King-Russell Patterson 1 Lovely, NE SE SW 29-14n-4e. Dry. TD 5,121 ft.

Logan County: Arthur Finston 1 Tibbitts, NE SE NE 35-16n-1e. Dry. TD 5,358 ft.

Sun Oil Co. 1 Zondler, SE NE NE 3-19n-3w. Dry. TD 5,938 ft.

Noble County: Max Pray and Elisha Walker 1 Rush, NE NW NW 8-23n-2w. Dry. TD 4,565 ft.

Okfuskee County: An-Son Petroleum Corp. 1 Replogle, SE NE NW 30-13n-8e. Dry. TD 4,216 ft.

* Seminole County: Deep Rock Oil Corp. 8 Davis C E½ E½ NW 30-8n-8e. IPP 136 BOPD, second Wilcox 3,919-24 ft. TD 3,990 ft. (New Pay at Wewoka townsite.)

KANSAS

Butler County: R. J. Wixson 1 Louis, SW SE NW 1-27s-4e. Dry. TD 2,858 ft.

Coffey County: Rex & Morris 1 Beine "B," NE NE NE 4-23s-15e. Dry. TD 1,538 ft.

Cowley County: Crest 1 McCormick, NW NE NW 34-34s-3e. Dry. TD 3,425 ft.

Rex & Morris 1 Birdzell, NW NW NE 6-34s-4e. Dry. TD 3,373 ft.

Dickinson County: Lotus 1 Foster, NW SE NE 29-14s-4e. Dry. TD 2,170 ft. Mississippi 2,156 ft.

Ellis County: Musgrove 1 Chesney, SE SW NE 17-11s-16w. Dry. TD 3,415 ft.

Ellsworth County: Lewis Drilling Co. 1 Wagner, NE SE SE 24-17s-9w. Dry. TD 3,287 ft.

Greenwood County: McGinnis-Armer 1 Schwab-Belcher, NE SE SW 9-24s-10e. Dry. TD 2,876 ft.

Marion County: Slusser 1 Riffel, SE NE NW 27-18s-4e. Dry. TD 2,424 ft.

McPherson County: Anschutz 1 Suffield, NW NW SW 12-19s-4w. Dry. TD 3,846 ft.

Ness County: Transit Corp. 1 Castor, NE NE NW 32-17s-26w. Dry. TD 4,565 ft.

Pawnee County: C. Todd 1 Reed, NW NW NE 9-22s-16w. Dry. TD 3,928 ft.

Pratt County: Lion 2 Airport, SW NW NW 8-27s-13w. Dry. TD 4,545 ft.

Russell County: Fleming and Woodman et al 1 Hartman, NE NE SW 25-11s-15w. Dry. TD 3,419 ft.

* Sheridan County: Westpan Hydrocarbon 1 Wessel, SW NW NW 27-6s-29w. IPP 216 BOPD, Lansing-Kansas City 4,002-18 ft. TD 4,720 ft. (Opens Wessel pool.)

Sumner County: Herndon Drilling Co. 1 McProud, SE SE SE 34-34s-1w. Dry. TD 4,279 ft.

NEBRASKA

Cheyenne County: Plains Exploration 1 Rezanina, NW NW SW 22-13n-49w. Dry. TD 5,010 ft. Skull Creek 4,956 ft.

Ohio Oil Co. 1 Miller, SE SE SW 14-15n-49w. Dry. TD 4,740 ft.

CALIFORNIA

Kern County: H. F. West 1 West-Lawson-Bennet, 26-30s-29e. Dry. TD 3,012 ft.

The Texas Co. 2 Occidental, 31-26s-19e. Dry. TD 2,782 ft.

E. A. Bender 35-13 "Well," 13-29s-28e. Dry. TD 1,745 ft.

Superior Oil Co. 10 Bankline, et al, 19-26s-21e. Dry. TD 3,115 ft.

Ferguson & Bosworth 1 Edwards, 24-29s-20e. Dry. TD 600 ft.

Ferguson & Bosworth 1 Superior-Anderson, 30-29s-21e. Dry. TD 451 ft.

San Luis Obispo County: Shell Oil Co. 83-25 McDonald Estate One, 25-29s-17e. Dry. TD 4,915 ft.

Sutter County: Richfield Oil Corp. 7 Butte Community B, 6-15n-2e. Dry. TD 2,725 ft.

Ventura County: Crestmont Oil Co. 8 Holser, 14-4n-18w. Dry. TD 5,250 ft.

Richfield Oil Corp. 2 Hillside, 8-4n-21w. Dry. TD 5,548 ft.

MONTANA

Fergus County: Flank Oil Co. 1 Ryan, NW SW SW 22-15n-23e. Dry. TD 3,400 ft. Charles 2,308 ft. Completed as water well.

UTAH

Uintah County: Sun Oil Co. and Continental Oil Co. 2 Unit, C SW NE 20-9s-20e. Dry. TD 10,498 ft. Mancos 10,495 ft.

COLORADO

Logan County: Ryan Oil Co. and Miracle & Fifer 1 Davis, NW SW SW 27-9n-54w. Dry. TD 5,338 ft.

Morgan County: Falcon-Seaboard 1 Funk, SE SE NE 8-2n-58w. Dry. TD 6,100 ft.

Washington County: Triangle "J" and Tuley & Carter 1 Hubbird, SW SE NW 20-2s-56w. Dry. TD 5,239 ft.

Reco Oil Co. and Eddie Fisher 1 "B" Frasier, SW SW NE 11-5s-56w. Dry. TD 5,244 ft. Lakota 5,210 ft.

Yuma County: Wayne Petroleum Co. 1 Churchill, NE NW NE 29-1s-45w. Dry. TD 3,682 ft.

* Weld County: Sherrod & Apperson 1 County, NE SE SW 1-3n-61w. IP 2,500 M.c.f. of gas per day, "J" sand 6,416 ft. TD 6,464 ft.

SASKATCHEWAN

* Socony-Woodey-Southern 23-1B N. E. Midway, LSD 1, 23-15-19w3. Roseray sand, oil well. TD 3,630 ft.

Husky 3 Green Street, LSD 12, 32-51-26w3. Dry. TD 1,802 ft.

Calvan & Associates 16-19 Wapella, LSD 16, 19-14-1w2. Dry. TD 3,256 ft.

ALBERTA

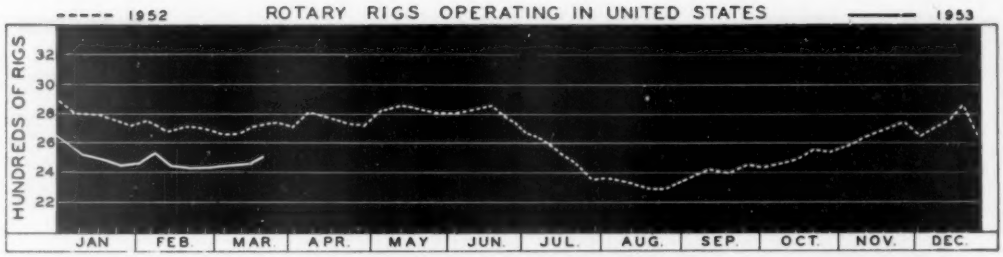
* Imperial 6-29 Calmette, LSD 6, 29-58-25w4. Viking sand gas well. TD 2,770 ft.

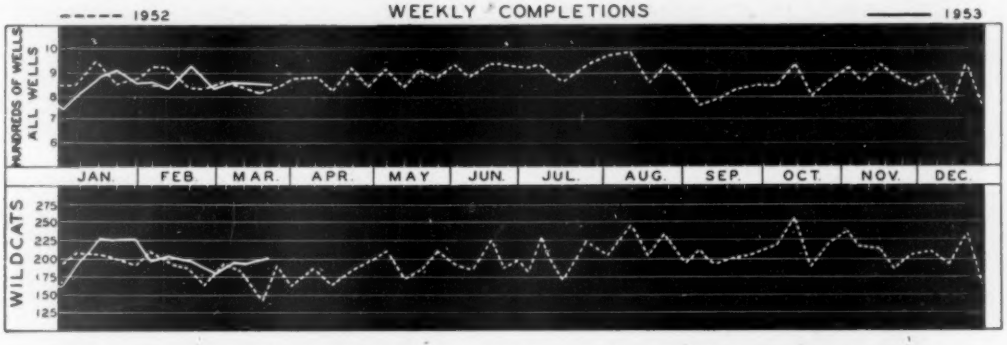
* Mavgill-Hy-Charger 1 Henderson Holdings, LSD 7, 34-54-25w4. Basal quartz oil well. TD 3,800 ft.

* Sinclair-CPR 1 Gierre, LSD 6, 15-33-13w4. Basal quartz gas well. TD 4,305 ft.

O. I. L. 1 La Biche, LSD 7, 22-70-17w4. Dry. TD 1,735 ft.

Pacific 2 St. Germaine, LSD 4, 32-86-22w5. Dry. TD 5,797 ft.





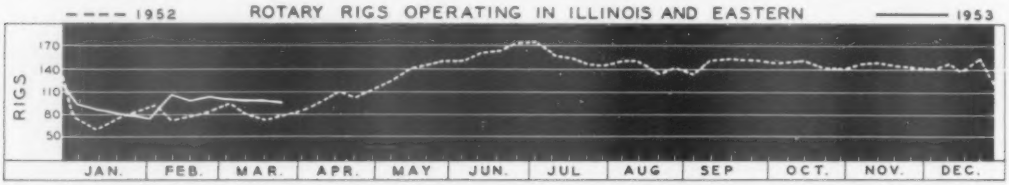
CURRENT STATISTICS

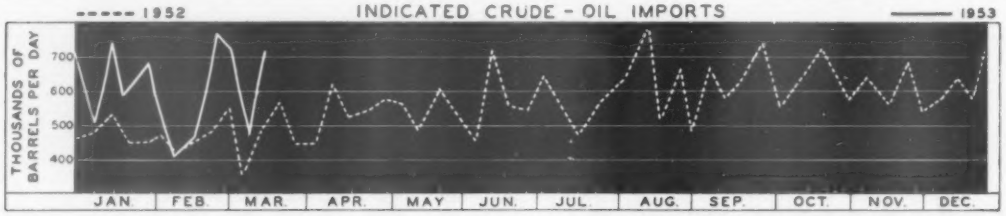
EXPLORATION

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 21, 1953

	Total of all wells					Mar. 21		Wildcat completions and discoveries					Cumulative total, 1953				
	Comp.	Oil	Gas	Dry	Footage	1953	1952	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	15	7	0	*8	20,950	141	147	0	0	0	0	0	0	0	0	0	0
Pennsylvania	35	17	3	†15	58,250	356	351	0	0	0	0	0	0	0	3	6	9
West Virginia	9	3	5	1	25,087	114	140	0	0	0	0	0	0	0	1	1	2
Ohio	17	8	2	‡7	42,605	204	210	0	0	0	0	0	1	0	0	4	5
Indiana	23	8	0	15	42,543	262	232	0	0	0	5	5	5	0	1	60	66
Kentucky	24	5	6	13	53,851	222	281	0	0	1	4	5	4	0	3	41	48
Illinois	20	9	0	11	52,402	393	339	0	0	0	5	5	1	0	0	75	76
Michigan	6	1	0	5	17,771	124	130	0	0	0	4	4	6	0	1	48	55
Kansas	76	26	6	44	251,404	982	1,062	1	0	0	15	16	25	0	8	163	196
Nebraska	3	1	0	2	15,325	58	52	0	0	0	2	2	5	0	0	24	29
Oklahoma	128	82	4	‡42	508,319	1,454	1,374	2	0	0	9	11	16	3	6	131	156
Texas	352	189	30	133	1,633,576	3,574	4,049	17	1	7	93	118	195	17	44	896	1,152
North Central (Dist. 7-B & 9)	117	73	0	44	444,963	1,240	1,264	11	0	0	30	41	104	0	4	364	472
West (Dist. 7-C & 8)	86	62	1	23	438,302	787	1,271	2	0	1	19	22	33	1	2	140	176
Panhandle (Dist. 10)	21	9	12	0	70,945	172	161	0	0	0	0	0	0	2	0	6	8
Eastern (Dist. 5 & 6)	19	9	0	10	88,476	171	178	0	1	0	5	6	5	1	0	55	61
Gulf Coast (Dist. 2 & 3)	58	17	9	32	354,774	556	602	3	0	4	21	28	29	3	21	137	190
Southwest (Dist. 1 & 4)	51	19	8	24	236,116	648	573	1	0	2	18	21	24	10	17	194	245
Louisiana	35	18	4	13	281,917	546	514	2	1	0	7	10	14	2	5	72	93
Northern	13	7	1	5	57,898	235	278	0	0	0	3	3	1	0	0	29	30
Southern	22	11	3	8	224,019	311	236	2	1	0	4	7	13	2	5	43	63
Arkansas	9	5	0	4	35,875	96	83	0	0	0	2	2	4	0	0	20	24
Mississippi	6	1	1	4	44,298	77	102	0	0	1	3	4	5	0	1	36	42
Southeastern States	2	0	0	2	13,254	33	13	0	0	0	1	1	1	0	0	25	26
Montana	3	1	0	2	10,825	83	33	0	0	0	1	1	1	0	0	23	24
Wyoming	11	9	1	1	48,856	123	127	0	0	0	0	0	1	0	0	27	28
Colorado	8	1	2	5	40,043	106	91	0	0	1	5	6	2	0	2	63	67
Utah	1	0	0	1	10,498	18	17	0	0	0	1	1	1	0	0	13	14
New Mexico	21	11	7	3	116,677	270	199	0	0	0	2	2	5	0	4	34	43
California	44	33	1	10	147,459	542	565	0	0	0	10	10	12	0	2	125	139
North Dakota	8	6	0	2	67,333	56	4	0	0	0	0	0	0	0	0	12	12
Miscellaneous	0	0	0	0	0	9	15	0	0	0	0	0	0	0	0	7	7
Total United States	856	441	72	343	3,539,118	9,843	10,130	22	2	10	169	203	304	22	81	1,906	2,313
Total previous week	862	432	87	343	3,515,141	....	....	25	0	10	156	191	282	20	71	1,737	2,110
Total March 22, 1952	843	440	50	353	3,634,161	....	....	29	6	3	150	188	319	24	53	1,796	2,192

Service wells included: *8, †13, ‡2.

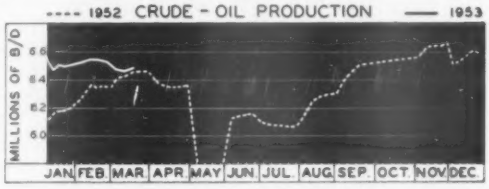


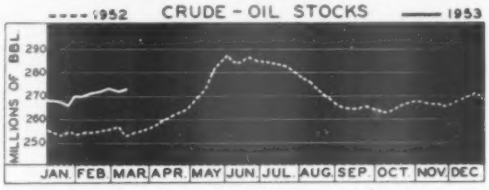


DAILY AVERAGE PRODUCTION FOR WEEK

	March 21			Mar. 14
	Crude oil	Lease condensate	Total	total
Alabama	4,400		4,400	4,300
Arkansas	76,800	650	77,450	78,950
California	992,600		992,600	991,700
Colorado	90,900		90,900	83,800
Eastern	56,000		56,000	56,000
Florida	1,475		1,475	1,475
Illinois	161,100		161,100	161,300
Indiana	33,600		33,600	34,000
Kansas	355,900		355,900	319,700
Kentucky	29,600		29,600	29,600
Louisiana	686,175	42,100	728,275	729,225
North	112,850	2,600	115,450	116,400
South	573,325	39,500	612,825	612,825
Michigan	34,700		34,700	35,600
Mississippi	92,550	4,650	97,200	96,900
Montana	32,500		32,500	29,500
Nebraska	12,800		12,800	12,700
New Mexico	180,675	600	181,275	181,075
Oklahoma	543,600		543,600	542,400
Texas	2,791,650	50,425	2,842,075	2,841,225
Dist. 1	36,800	250	37,050	37,050
Dist. 2	151,675	6,000	157,675	157,675
Dist. 3	459,075	25,700	484,775	484,775
Dist. 4	254,275	6,000	260,275	260,275
Dist. 5	48,500	500	49,000	49,000
Dist. 6	122,725	6,000	128,725	128,725
East Texas field	247,000		247,000	247,000
Dist. 7-B	104,950	100	105,050	105,050
Dist. 7-C	174,600	4,800	179,400	178,550
Dist. 8	931,325	350	931,675	931,675
Dist. 9	188,000	700	188,700	188,700
Dist. 10	72,725	25	72,750	72,750
Utah	5,000		5,000	5,200
Wyoming	202,800		202,800	205,000
North Dakota	12,500		12,500	12,000
Total U. S.	6,397,325	98,425	6,495,750	6,451,650
Change from previous week, up			44,100	
Canada	165,000		165,000	160,000
Total U. S. production January 1-March 21			520,595,500 bbl.	
Same period last year (crude plus cond.)			*511,583,650 bbl.	

*Includes 7,787,010 bbl. condensate.





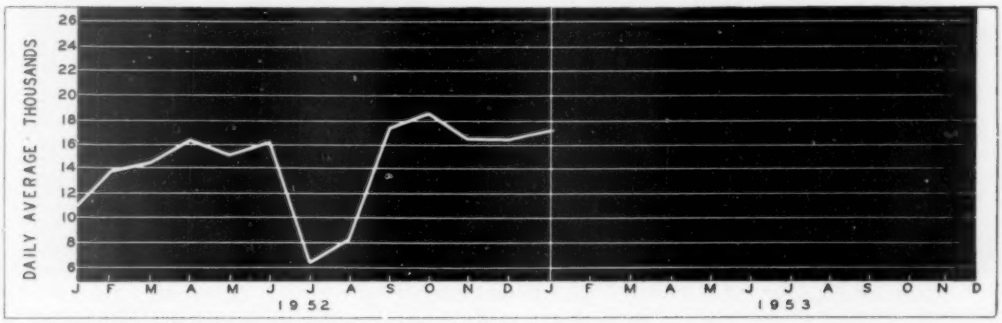
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

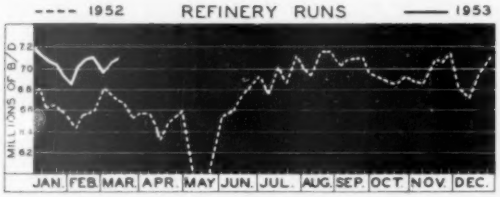
(Thousands of barrels)

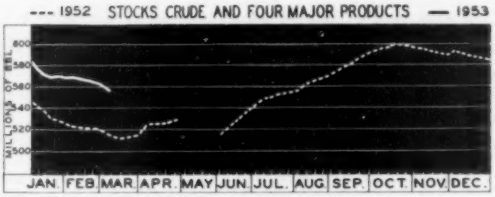
	Mar. 14, '53	Mar. 7, '53	Mar. 15, '52
Pennsylvania Grade	2,290	2,278	2,272
Other Appalachian	1,959	1,995	2,000
Illinois, Indiana, Michigan	10,755	10,526	11,581
Arkansas	2,821	2,824	2,940
Louisiana	16,972	16,147	13,922
North	3,267	3,097	2,896
Gulf	13,705	13,050	11,026
Mississippi	3,797	3,748	3,395
New Mexico	7,391	7,553	7,650
Oklahoma and Kansas	36,627	36,008	39,102
Texas	134,301	135,512	120,980
East Texas proper	10,983	11,307	10,449
West Texas	64,674	65,113	54,507
Texas Gulf	25,746	25,805	25,263
Other Texas	32,898	33,287	30,761
Rocky Mountain	15,759	15,656	13,442
California	32,869	32,921	30,385
Foreign	7,816	7,280	5,442
Total	273,357	272,448	253,111

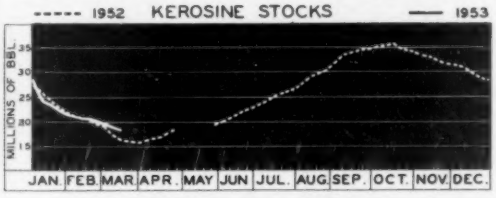
*Bureau of Mines.

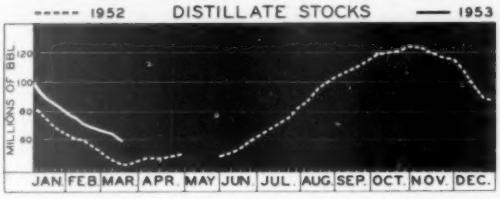
MOTOR-VEHICLE SALES (DOMESTIC MARKET)

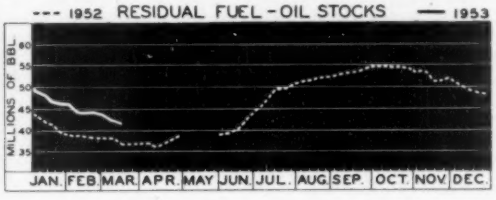










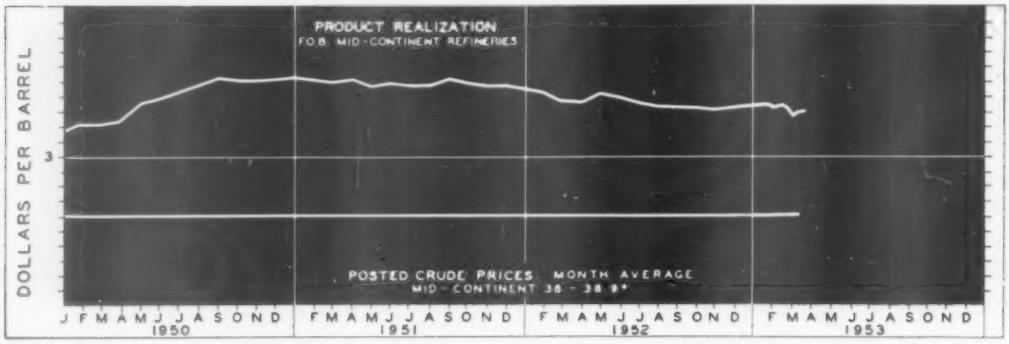


A.P.I. REFINERY REPORT, MARCH 21

(Thousands of barrels)

District—	Daily avg. runs	Daily average production: Gaso.*	Kero.	Dist.	Resid.	Stocks‡: Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, March 1952: Daily avg. runs	Daily average production: Gaso.*	Kero.	Dist.	Resid.
East Coast	1,025	411.6	52.6	244.7	225.0	35,469	8,133	19,549	10,407	940	385.3	44.3	226.6	229.6
Appalachian:														
District 1	113	45.7	5.7	19.7	17.0	4,061	410	938	453	109	49.0	5.8	14.8	13.2
District 2	102	45.9	8.4	14.6	14.4	1,838	318	386	168	71	35.2	4.2	11.6	17.6
Ind., Ill., Ky.	1,253	699.6	67.7	218.4	175.1	37,561	3,609	8,987	3,999	1,253	632.6	81.7	228.7	174.8
Okla., Kans., Mo.	574	338.3	10.1	127.7	56.6	18,697	1,164	6,719	1,079	535	293.9	18.2	119.6	63.8
Inland Texas	251	156.6	15.2	41.4	31.0	6,615	270	1,069	896	236	166.3	13.4	40.4	38.0
Texas Gulf Coast	1,794	782.1	165.0	415.3	258.6	22,744	2,330	7,083	6,190	1,705	727.1	145.4	391.6	265.2
La. Gulf Coast	553	258.0	60.7	167.3	53.0	8,220	1,164	3,483	1,497	499	240.3	49.9	143.9	59.0
N. La. and Ark.	84	30.3	7.6	17.6	4.6	3,361	448	1,105	93	71	31.6	6.7	19.2	4.9
Rocky Mountain:														
New Mexico	19	11.4	.....	2.7	3.9	142	.....	29	30	18	10.4	1.0	2.6	4.0
Other Rocky Mtn.	240	105.8	7.7	45.4	50.7	6,979	304	1,616	903	217	101.4	8.7	42.9	46.7
California	1,091	467.0	8.7	162.0	392.8	17,637	342	8,787	16,129	986	395.7	6.6	158.2	356.8
Mar. 21, 1953	7,099	3,322.3	409.4	1,476.8	1,277.7	163,324	18,492	59,751	41,844	6,640	3,068.8	385.9	1,400.1	1,273.6
Mar. 14, 1953	7,060	3,306.7	346.4	1,506.3	1,331.1	160,869	18,640	62,545	42,284	.....	.....	.....	.....	.....
Mar. 22, 1952	6,542	3,116.9	374.7	1,363.4	1,263.6	158,416	16,104	50,011	36,575	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipe lines.


PRODUCT REALIZATION
F.O.B. MID-CONTINENT REFINERIES
DOLLARS PER BARREL
3
POSTED CRUDE PRICES MONTH AVERAGE
MID-CONTINENT 38 - 38.8°
J F M A M J J A S O N D
1950
F M A M J J A S O N D
1951
F M A M J J A S O N D
1952
F M A M J J A S O N D
1953

In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate and fuel oil. Realization averaged $3.30 for week ended March 14, $3.29 for previous week, and $3.37 for March 1952. The above trend information is based on volumes and current prices and therefore does not reflect changes in operating costs.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotations of leading suppliers as of March 25, 1953. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline, 80-82 octane	10⅛-10½	12-12.75	10½-11
Premium gasoline, 86-88 octane	11¼-11½	13.125-14	11¾-12
42-44 w.w. kerosine	8⅜-8¾	10.40-10.65	9
No. 2 straw fuel oil	7⅜-7¾	9.40-9.65	8
No. 6 residual	$0.80-1.00	$1.90-2.15	$1.50-1.65

NATURAL GASOLINE

	Group 3	North Tex.	N. La.
Grade 26-70	5½	5	5¼
Grade 18-55	6.60	6.10	6.35

LUBRICATING OILS
South Texas

200 vis., No. 2-3 neutral	12-13
750 vis., No. 3-4 neutral	15-16
2,000 No. 5-6 neutral	17-18

LUBRICATING OILS
Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	21-22
200 vis., No. 3 neutral, 0-10 pp.	12-13

Western Pennsylvania

145-155 vis., 10 p.t. bright stock	26.5
180 vis., 0 p.t. neutral	29.5

WAX
Mid-Continent

132-134 A.M.P.	5.5

SOME of the larger independent suppliers in the New York Harbor area announced return to postings of $2.00 per barrel for residual fuel, following a period of about 5 weeks during which the reduction of 10 cents a barrel failed to bring in the expected new business.

This does not mean that material is not available in the harbor at $1.90. Some suppliers are still offering No. 6 at the lower price, and the continuation of spot tanker rates at about 40 per cent under the Maritime Commission base makes it possible to move heavy fuel into New York for about $1.75.

Primary suppliers had met the $1.90 price on a customer-by-customer basis, and some of these customers will not want to return to $2.00 while the market is still fundamentally soft.

Trading in residual fuel has been very limited on the Gulf Coast with the price remaining at $1.50. However, if East Coast marketers cut purchases of Gulf Coast residual in order to stabilize the East Coast market, the stock gain on the Gulf Coast will tend to soften the market in that area.

Premium-grade gasoline on the Gulf Coast is in good demand, but regular grades are under pressure despite recent movement to the West Coast. Excessive primary inventories of gasoline on the East Coast have resulted in price shading for unbranded grades. Gasoline stocks on the East Coast totaled 35,436,000 bbl. on March 14, up 5,196,000 bbl. from the corresponding date last year.

Current quotations by primary suppliers indicate that they are expecting a good gasoline season. While pressure from very high inventories is forcing some refiners to shade spot prices on material for immediate delivery, suppliers are quoting normal prices for April deliveries.

Small quantities of residual fuel from the Mid-Continent are moving at prices a little under the normal low for the past few weeks.

CRUDE PRICES
GRAVITY SCHEDULE

	Signal Hill, Calif‡	Okla. homa, Kansas	Gulf Coast Tex.*	West Tex.†
14-14.9	$1.87	....	....	....
15-15.9	1.93	....	....	....
16-16.9	1.99	....	....	....
17-17.9	2.05	....	....	....
18-18.9	2.11	....	....	....
19-19.9	2.18	....	....	....
20-20.9	2.24	$2.25	....	$2.12
21-21.9	2.30	2.27	....	2.14
22-22.9	2.37	2.29	....	2.16
23-23.9	2.45	2.31	....	2.18
24-24.9	2.53	2.33	$2.56	2.20
25-25.9	2.61	2.35	2.58	2.22
26-26.9	2.69	2.37	2.60	2.24
27-27.9	2.76	2.39	2.62	2.26
28-28.9	2.83	2.41	2.64	2.28
29-29.9	2.91	2.43	2.66	2.30
30-30.9	2.97	2.45	2.68	2.32
31-31.9	3.04	2.47	2.70	2.34
32-32.9	3.12	2.49	2.72	2.36
33-33.9		2.51	2.74	2.38
34-34.9		2.53	2.76	2.40
35-35.9		2.55	2.78	2.42
36-36.9		2.57	2.80	2.44
37-37.9		2.59	2.82	2.46
38-38.9		2.61	2.84	2.48
39-39.9		2.63	2.86	2.50
40 and above		2.65	2.88	2.52

*For crude from Daboval, El Campo, and Sand Point.

†Includes Lea County, New Mexico.

Last general price change represented a 50-cent increase, effective December 6, 1947.

‡Standard Oil Co. of California.

FLAT CRUDE PRICES

Representative posted schedules per barrel.

Louisiana:	
Beauregard Parish	2.60
Cotton Valley (distillate)	2.85
Cotton Valley (crude)	2.70
Texas:	
East Texas	2.65
Pecos County (Yates)	2.35
Conroe	2.83
Van	2.48
Pennsylvania Grade:	
Bradford	4.40
Southwest Pennsylvania	3.97
West Virginia	39.1
Illinois Basin	2.77

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1 OILWELL Steam Pump, 16¼ x 7¾ x 20" This pump is in excellent condition, may be seen at Makin Drilling Company Yard. Hobbs, New Mexico. Makin Drilling Company, Box 1628, Hobbs, New Mexico.

FOR SALE: Jennings, Louisiana, many used steel storage tanks. 100 to 37,000 bbl. Hardware, connections and pumps. Southern Oil Agency, P.O. Box 880, Jennings, Louisiana.

2—OILWELL 3" x 6" Triplex Power Pumps w/ porcelain plungers. 7—75 HP, 440-V, 900 RPM, Open type electric motors. 13—6 groove D-section sheaves 15" to 34" diameter. 4000'—11½" Cement Lined Pipe. Morrison Producing Company, P. O. Box 712, El Dorado, Kansas.

KEYSTONE Spudder trailer mounted truck and tools. Located Washington County, Oklahoma. $1800.00. Working on well, ready to move. Box G-384, The Oil and Gas Journal, Tulsa, Oklahoma.

1—1000 H.P., 600 KW, 300 RPM, COOPER BESSEMER, Type LTG natural gas engine. 1—500 H.P., 350 KW, 225 RPM, FULTON, Class BGG, natural gas engine. 2—300 H. P., 200 KW, 200 RPM, FULTON, Class 3 BG Diesel Engines. (All 3 phase, 60 cycle, 2300 volts). Units can be seen in operation. 12—300 H.P., 900 RPM, STERLING - VIKING natural gas engines only. Completely rebuilt and guaranteed. MAX E. LANDRY, INC., P.O. Box 2238, Tulsa, Oklahoma. Ph. 72-1519.

14 miles 6⅝" O.D., seamless, weight 18.97, Range 2. 1½ miles 4½" O.D., seamless, weight 8.64, Range 3. All above pipe laid in 1943, clean inside, all beveled for welding, cleaned outside, located Cushing and Cleveland, Oklahoma. Guaranteed A No. 1.

W. C. BERRY
Box 1858, Tulsa, Okla. Phone 3-6141

EQUIPMENT FOR SALE

FOR SALE: Cardwell, model RL, Beam type cable tool drilling unit. At present in operation in West Central Kansas. Complete inventory and price furnished on request. K & A Drilling Co., Phone 448R or Box 497, Ellinwood, Kansas.

FOR SALE: One 36"x11' 125# WP Std BS&B Vertical Separator complete w/valves and safety head. One 3 phase 220-440V, 75KW Generating Unit w/all controls built in direct connected to 165 HP GMC Diesel Engine. Phone 9-3193 or box 1724, Billings, Montana.

CATERPILLAR D4 Tractor with Trackson Pipelayer in excellent condition. Will rent with purchase option. Write—J. W. Kerby, Chanute, Kans.

FOR SALE

Approximately 100 miles 6⅝" O.D. 18.97# Used Lapweld Line Pipe in single random lengths, plain ends beveled.
This pipe is cleaned, primed and beveled and is offered FOB Indianapolis, Indiana, subject to inspection and acceptance at location. Prices are reasonable, with special consideration to dealers.
We solicit your inquiries for all or part of this pipe, and for further information please write or call:

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HUnter 4651

STANDARD PIPE SUPPLY COMPANY
P. O. Box 243, Houston, Texas
CHarter 6976

DAVIDSON PIPE COMPANY, INC.
2nd Avenue 50th St., Brooklyn 32, N. Y.
GEdney 9-6300

TEXAS PIPE & SUPPLY COMPANY
P. O. Box 1331, Houston, Texas
BLackstone 0101

EQUIPMENT FOR SALE

87' Lee C. Moore Cantilever Derrick located East Central Oklahoma. Drilled one well since complete overhaul by Lee C. Moore. 4½' substructure, steel floor, 4' drop wings. $8,000.00. Box G-329, The Oil and Gas Journal, Tulsa, Oklahoma.

WELL drilling equipment, new or used Spudders, rotaries, core & shot hole drills, tools, pipe, bits, blocks, pump jacks, valves Everything for well drilling and service Fishing tools rented. Pressey & Son, Pueblo, Colo.

Gaso Duplex 4½" x 6" Power Pumps with Chrysler C-36 Engines, skid mounted, immediate delivery. Also Byron Jackson, Carter Centrifugal Units. Westinghouse 20-25-50 KW Generating Units.

H. H. COFFIELD
Attn.: W. H. ORR
Phones: 132—Rockdale, Texas
AT-3427—Houston, Texas

FOR SALE

Complete National 100 Rig including 3 PTD-6 Superior Diesel Engines with dual fuel equipment, 136' Lee C. Moore Mast with 8' substructure, 2 C-350 Ideal Power Pumps, Ideal Type 548 TC Traveling Block, Type R3 Swivel, and Type MS-20½ Rotary Table. Excellent condition, priced reasonable, located in Montana. Complete inventory upon request.

Box G-341

The Oil and Gas Journal,
Tulsa, Oklahoma

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FOR SALE: Model P oil well mud pump 6 X 12, A1 condition, can be inspected, ideal for light rotary or reverse circulator. $4500.00. Davon Drilling Company, Oklahoma City, Okla.

FOR SALE: 2—New B. J. Multiplex 6 x 8 x 10 pipe line pumps, 1000 Gal. @ 400 ft., maximum head 2000′, List $3468.00 each, Our Price $1250.00 each. Bender Oil Operations, P.O. Box 52, Bakersfield, California.

FOR SALE: Gardner Denver 4½ x 5 FXF Mud Pump—Good condition. Whitlock, 2062-R, Pampa, Texas.

FOUR 8′ x 7′6″ National Oil Treating Heaters. Good condition except some minor accessories should be replaced. Address inquiries to Gulf Refining Co. Attention Rea Fulkerson, Box 477, Centralia, Ill.

FOR SALE: 1 43 Star spudder complete with tools. Price $6500.00. Four miles east of Delaware, Oklahoma. Call Tulsa 3-3390. After five 54-1488. C. L. Sutton.

FOR SALE: 80,000′ 4½ O.D. S.S. line, 60,000′ 3½ O.D. line, 60,000′ 6⅝ S.S. line. Lundquist Pipe & Supply Co., Phone 5-8850, Tulsa, P.O. Box 1215.

FOR SALE: WILSON GIANT SPUDDER with double mast pole. All tailing-in tools for 5½ and 7 inch. Also rotary equipment used as combination rig. All equipment in A-1 working condition and priced to sell for cash. Call Ray Willis, Phone 924, Mt. Carmel, Ill.

FOR SALE: One Barrel Type Ethyl Lead Plant. Hutex Oil & Refining Company, P. O. Box 2146, Houston, Texas.

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2⅝" DRILL - STEM PRESSURE RECORDERS

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4—14x14 Ideal Ajax Steam Twin Cylinder Engines
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5—14x7½x18 Wilson Snyder Mud Pumps
8—150# Pressure Firebox Boilers
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10—10x4½x10 Wilson Snyder Boiler Feed Pumps
2—7.4½-10 Wilson Snyder Boiler Feed Pumps
2—300 Ton OWS Swivels Type D
2—12¼" Regan 6 Sheave Streamline Traveling Blocks, 1¼" line
3—7⅝" 5 Sheave Regan Traveling Blocks, 1¼" line
2—6⅞" 5 Sheave Regan Traveling Blocks, 1¼" line
3—300 Ton B.J. Casing Hooks
2—National Model 34-32-9 Drawworks 40" Hydromatic
2—Emsco Model UB-54-10 Drawworks 40" Hydromatic
9,000′—5" 15.5# Left Hand Drill Pipe Range 1 in doubles Grade D
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7—350# Foster Wheeler Portable Superheaters

All material located in Kettleman Hills, Calif.

Pierce Road Supply Co.

P. O. Box 502 Bakersfield, California

EQUIPMENT FOR SALE

FOR SALE: Moore cantilever derrick; Wilson Giant two motor draw works; two pumps, rotary; block and hook. Write Box 3246, Corpus Christi, Tex.

1—CARDWELL Q rod & tubing unit with 7 x 8 telescoping mast. Mounted on 1950 2-ton Chevrolet truck. Some tools. Write or call Kent Well Servicing Company, Phone 1068, El Dorado, Kansas.

FOR SALE—Caterpillar D4 with Hydraulic angle blade. Good condition, wide gauge. Atlee Schlabach, Charm, Ohio.

FOR SALE: Franks "2000" Rotary Drill, on tandem lowboy trailer—exceptionally good shape. Contact R. F. Hare, 2018 W. T. Waggoner Bldg., Fort Worth. Ph. FA-4646.

SALES and rentals of cable drilling and fishing tools, casing and equipment, from the Southwest's largest stock of used cable tools and oil field supplies. Degen Pipe and Supply Co., Tulsa, Oklahoma.

USED ROTARY, cable tools, and production equipment. E. A. Kelly, 3131 S.E. 29th Street, P. O. Box 861, Oklahoma City. Phone Jackson 56407.

FOR SALE: One double drum Super-Mogul Wilson Spudder, powered by PA-100 International motor. $1500.00. Fox Well Servicing Company, Healdton, Oklahoma.

PIPE FOR SALE: 750′ 5½" Lapweld long couplings #1, $1.50. M. J. Regan, Coffeyville, Kansas.

FORT WORTH, Model-D Spudder complete with International power unit, tools for 22" diameter holes, located near Los Alamos, New Mexico. Inventory furnished upon request. Texas Water Wells, Inc., 951 McCarty Drive, Houston, Texas.

FOR SALE: Closing out an Estate, 1,000 barrel per day topping and asphalt plant. Crude oil and trained personnel available with plant. Located in an industrial Rocky Mountain community. Write Box 245, Shelby, Montana, for particulars.

JOY 300 Drilling Rig butane powered, mounted on Brockaway 6x6 truck. 3500 feet 3½ inch drill pipe. Auxiliary mud pump and butane engine as separate unit. All tools and equipment included. This rig in first-class working condition and can be seen working now. Call or write Steele Brothers, Crete, Nebraska. Phone 127.

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NEW DRILL PIPE 5800′ 4½ OD extra full hole, Hughes flashweld tool joints, Grade D. Contact Pete Thomas, 6-8075, Tulsa, Oklahoma, Box 2182.

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1. Seven (7) 1 hp., Model 5B 203A13, type B. frame, 200 #203 Shunt Wound, 115 Volts, 1750 R P M. Enclosure Open, Continuous Duty. DC Electric Motors.
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For full detailed information and price, CALL, WRITE or WIRE

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Mid-Continent Supply Co.

Box 189 Fort Worth, Texas

EQUIPMENT FOR SALE

GAS METERS FOR SALE. Westcott, Foxboro and Emco. Good condition. Geo. R Milner, Box 124, Okmulgee, Oklahoma.

TWO used 5,000-barrel steel tanks located Sunburst, Montana, one in good condition, one fair. Hardrock Oil Co., Box 1242, Great Falls, Montana.

EQUIPMENT FOR SALE: 500 KW operating 480 volt power plant complete with 2 Worthington 300 HP type CG-5 vertical 4 cycle gas engines, 1 Worthington 150 HP type BG-5 gas engine, 2 General Electric 200 KW generators, 1 General Electric 100 KW generator, 1 General Electric 5 KW exciter, and General Electric switchboard. American Liberty Oil Company, Box 1011, Mt. Pleasant, Texas.

FOR SALE: Wilson Giant Spudder with double mast pole. All tailing-in tools for 5½ and 7 inch. Also rotary equipment used as combination rig. All equipment in A-1 working condition and priced to sell for cash. Call Ray Willis, Phone 924, Mt. Carmel, Ill.

WE have available a revised list of surplus used tubular material ready for mailing. Cities Service Oil Company, Patridge, Bartlesville.

FOR SALE: Three secondhand 8,000 gallon tank car tanks. Suitable overhead or underground stationary storage. $475.00 each, F.O.B. Texarkana. North American Car Corporation, Kirby Building, Dallas, Texas.

FOR SALE: Mayhew #1000 Drilling Unit in good condition with auxiliary pump motor all mounted on 1½ ton Chevrolet Truck. Ready for immediate field operation. Will sell with 170 feet of pipe, with or without water truck. If interested write Box 336 or Call 1555-J, Monahans, Texas.

FOR SALE: 85,000′ 2⅜" EUE, 4.70# R-2 Seamless used Tubing all tested to 2000#, also quantities of used Seamless and Lapweld Casing. Sabine Pipe & Supply Co. Phones 3094, 3095, 5533, Kilgore, Texas.

FOR SALE: 8—Shriver 42"x42" cast iron Filter Presses, Plate & Frame type, 18, 27, and 54 chambers, 1" cake; 15—Sperry 18"x18" cast iron Filter Presses, 11 chambers; 2—#12 Sweetland Filters for 36 leaves on 4" centers. Immediate shipment. Attractively priced. Consolidated Products Co., Inc., 17-20 Park Row, New York 38, N. Y. BArclay 7-0600.

STORAGE TANKS—FOR SALE: Three—55,000 bbl. steel tanks with steel roofs. Jimmy Heath, Henrietta, Texas.

FOR SALE: R. L. Dubbledrum Cardwell fully equipped. Oklahoma City, Oklahoma, Melrose 8-5108.

EQUIPMENT WANTED

WANTED: Three engine compound for Wilson Titan drawworks. Makin Drilling Company, Box 1628, Phone 3-3141, Hobbs, New Mexico.

WANTED: One Thrible Jack-knife and substructure. No Junk Wanted. Makin Drilling Company, Phone 3-3141, Hobbs, New Mexico.

WILL PAY highest prices for used casing, used line pipe, abandoned leases, or other surplus lease equipment. Your idle producing equipment is worth dollars. Green Pipe & Supply Co., Box 1383, Tulsa, Oklahoma.

WANTED to buy, small vacuum tower and other vacuum equipment. Box G-382, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

FOREIGN EMPLOYMENT. List of oil companies and drilling contractors showing where to apply for foreign jobs. OIML Co., Box 2603, Tulsa, Okla. $5.00 cash.

RESEARCH GEOPHYSICIST to head group doing theoretical and interpretative research in exploration geophysics for major oil company. Location in Mid-Continent Region. Ample opportunity for well-qualified man with advanced training and experience. Please give complete history of education and experience in first letter. Reply will be kept confidential. Address Box G-364, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

WANTED: High salaried oil office executive, with experience in handling organization partly abroad. Office in New York. Man 40 to 50 preferred. All correspondence will be absolutely confidential. Box G-353, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMICAL ENGINEER—Responsible engineering position with well-established consulting engineering firm rendering diversified services to industry. Good educational background essential. Experience in petroleum, petrochemicals, fertilizers, market research, economics, process design desirable. Opening immediate. Salary commensurate with ability. Box G-393, The Oil and Gas Journal, Tulsa, Oklahoma.

MASTER Mechanic, qualified to install and maintain large diesel engines as well as pumps and accessory equipment on pipe line. Must be capable of organizing and directing maintenance program. Location, North Central Area. Please include experience and salary expected in reply. Box G-380, The Oil and Gas Journal, Tulsa, Oklahoma.

MAN experienced in construction and operation of small Natural Gas Distribution Systems. Registered Engineer Preferred. Permanent location in Southeast. Box G-365, The Oil and Gas Journal, Tulsa, Oklahoma.

GRADUATE engineers with gasoline plant experience qualifying them for supervisory and staff positions needed for Venezuela. Write The Carter Oil Company, Box 801, Tulsa, Oklahoma, giving age, education, marital status, and experience. Box G-368, The Oil and Gas Journal, Tulsa, Oklahoma.

CIVIL and Mechanical Engineers. Piping and Structural Draftsmen for positions with Major Oil Company in Refinery Engineering Department, located in Tulsa. State qualifications and salary expected. Write Personnel Department, Post Office Box 381, Tulsa 2, Oklahoma.

THE University of Tulsa has an opening for a qualified faculty member with masters or substantial experience. Reasonable salary and opportunity for consulting and research. If interested contact Head of Petroleum Production Engineering Department, Tulsa, Oklahoma.

SEISMIC PERSONNEL needed for United States and Canada by well known and expanding contract geophysical company. Address Box E-863, The Oil and Gas Journal, Tulsa, Oklahoma.

INDEPENDENT gas producer needs experienced production superintendent familiar with drilling, completions and producing operations in East Texas and North Louisiana. Replies confidential. Box G-388, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL Industry Employment Service, 405 Tuloma Bldg., Tulsa, Okla. 4-5974. Tom Robinson, owner. For Technical and Trained Personnel, including LPG.

SYSTEMS & METHODS DIRECTOR

Good career opportunity for man experienced in utility customer accounting. Must also have systems and methods experience, though not necessarily in the utility industry. Age 26 to 45. We are a natural gas utility company engaged in production, transmission, and distribution in four states. We offer a full program of employee benefits. Apply by letter to: SOUTHERN UNION GAS COMPANY, Burt Building, Dallas, Texas, Attn.: Mrs. Singer.

DIVISION GEOPHYSICIST — Position open. Good salary. Require well qualified geophysicist, with geological education or training, and at least three years' experience in Permian Basin. Write:—Union Oil Company of California, 200 Wilkinson-Foster Building, Midland, Texas. Attention:—Mr. H. L. Swords.

SITUATIONS WANTED

SALES REPRESENTATIVE position wanted in Oil Industry. 8 years varied Major Company experience, married, age 30. Box G-392, The Oil and Gas Journal, Tulsa, Oklahoma.

COMPRESSOR operator, four years' experience, desires connection with Company in Gulf Coast Area. Married. 35 years of age. Box G-398, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

GEOLOGIST—Ph.D. with many years experience in all phases of petroleum exploration and with an outstanding record of successful oil and gas finding. Will be available April 1st for full time work or on a part-time retaining basis. If you need ideas for drilling prospects, this is an excellent opportunity and should be investigated. Box G-373, The Oil and Gas Journal, Tulsa, Oklahoma.

COMPLETION and production man experienced in Acidizing, Fracturing and workover desires change. Now employed in West Central Texas. Box G-370, The Oil and Gas Journal, Tulsa, Oklahoma.

GRADUATE CIVIL ENGINEER, 28, married, 5 years crude oil trunk line experience. Desire more experience in design or construction with minimum travel. Need confidential consideration. Box G-378, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPERIENCED oil operator wants to represent parties planning active drilling program in Texas, retainer and interest basis. Bank references. Box G-383, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEER, Math. Masters. 4 years P.E. experience, all phases, desires chance to get into teaching. Resume on request. Box G-340, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST — 32, family, seven years thorough major company exploration experience, geology and geophysics, both field and home office prospect finding and evaluation, wants job with independent company Rocky Mountain Area. Box G-397, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL Refinery Sup't Available, Prefer Marine, Bulk Station or Pipeline Terminal Supervision. Age 50. Box G-396, The Oil and Gas Journal, Tulsa, Oklahoma.

GRADUATE engineer, 32 years old. Married. Some experience map drafting, surveying, property taxes. Prefer Houston area. Box 1162, Houston, Texas.

GRADUATE PETROLEUM ENGINEER: Married, age 32, 7 years experience production and drilling, Gulf Coast area. Desires permanent position w/growing organization. Box G-337, The Oil and Gas Journal, Tulsa, Oklahoma.

ATTENTION: Well established oil well drilling contractor desires to manage and supervise: Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas, and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No. 1628, Ph. No. 3-3141, Hobbs, New Mexico

EXECUTIVE Secretary: Extensive oil and legal experience. Prefer small office. Box G-395, The Oil and Gas Journal, Tulsa, Okla.

GEOLOGIST, 5 years' experience in various localities, some petroleum engineering, desires District Geologist position or equivalent. Box G-399, The Oil and Gas Journal, Tulsa, Oklahoma.

REFINERY PROCESS SUPERVISOR

Chemical Engineer with thirteen years diversified experience in petroleum refineries, including administration, process supervision, technical service and development, desires supervision, technical service and development, desires permanent position as superintendent or assistant of smaller refinery or supervisor in larger refinery or petro-chemical plant. Available August. Age 35, family. **Box G-400, The Oil and Gas Journal, Tulsa, Oklahoma.**

BUSINESS OPPORTUNITIES

DRILLING DEAL WANTED

Have spudders, labor, cash and repressuring experience. Would like to make drilling deal on shallow repressuring project for part cash and interest.

Box G-403, The Oil and Gas Journal, Tulsa, Oklahoma

ROYALTIES

PRODUCING ROYALTY and overrides for sale. Wire-write-call for particulars. JACK EAGLE, 706 City Natl. Bldg., Okla. City, Okla. REgent 6-7027.

QUICK CASH: Producing royalties, Overrides or Production . . . no delay. Phone 72-4533, Robert L. Kinkaid . . . P.O. Box 26, Tulsa, Oklahoma.

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High Grade Only
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P.O. Box 2151

LEASE AND DRILLING BLOCKS

GET in on the shallow Oil Play on the West side of the Illinois Basin for drilling blocks call or write W. S. Miller, Assumption, Ill., or Alfred M. Branyan, Moweaqua, Ill. Phones Assumption 90 or Moweaqua 2446.

DALLAM COUNTY, TEXAS: 8000 acres solid block one owner. ⅛ County leased to Major Companies. $1.25 bonus, $1.00 rentals, 10 year commercial lease. Combest Royalty Company, Amarillo, Texas.

WILL pay cash instantly for leases (large blocks), royalties, mineral deeds, production. Write fully—P. O. Box 2153, Denver, Colorado.

162 A. TEN YEAR oil lease, $1600. .50c rental, Carbon Co., Utah. Near Equity 8000' Ft. Penn-test, nr Carbon-Dioxide gas well. R. Barnsley, 950 Lincoln Ave., Palo Alto, Calif.

LEASES $2 acre up. Over 600 Oil and Gas Fields Struck in Texas 1952. Buy Production Right. References. E. M. ADAMS, Marshall, Texas.

LEASES Wanted in Kansas: Proven or semiproven oil leases in Kansas or other promising territory wanted. Would develop good leases and carry owner for override. Box G-401, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: 155 acres on promising structure. Producing oil and gas wells on north and west. John Harlow, Louisburg, Kans.

IF YOU have wanted to invest in the heart of the Williston Oil Basin, here is your chance to buy quarter or half interest in oil rights only of 109 acres. All offers over $50.00 an acre quarter interest considered. Land located between several producing fields. Reputed to be in heart of Basin. Box G-402, The Oil and Gas Journal, Tulsa, Oklahoma.

LEASE 3,000 acres Vermillion Basin $1.00 acre rental, $1.00 bonus and small override. 45 ft. Simpson sand at 990 ft. near Platte Pipe Line. H. T. Harper, Vermillion, Kansas.

5000 ACRES-2800 acres GRAY COUNTY, TEXAS, Semi-proven oil and gas 3000'. Small cash bonus and little override. 5 year commercial lease $1.00 rentals. Combest Royalty Co., Amarillo, Texas.

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Producing and Nonproducing

Bought and Sold—Any Area

Inquiries Invited

B. D. BUCKLEY

6835 Delmar Ave., St. Louis 5, Mo.

DRILLING PROPOSITIONS WANTED

Am ready to cut a few more holes. Will drill proven; semi-proven or wildcat. Submit complete information, including geology, if available. All propositions held strictly confidential. **Box G-376, The Oil and Gas Journal, Tulsa, Oklahoma.**

WANTED

WANTED to purchase Petroleum statistical guide (Vance Rowe) monthly reports for Western Kansas—years 1941 through 1952 in good readable condition. Box G-360, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL PRODUCTION

FOR SALE: About 250 bbls. settled production with possibilities for a great increase. Box G-375, The Oil and Gas Journal, Tulsa, Oklahoma.

RANCHES

WYOMING RANCH

8,160 acres deeded land; 7,680 A. leased land of which 5,000 A. are irrigated meadow and pastureland. Will summer 2,500 cattle; beside putting up enough hay to winter 500 cows. Good set working improvements. 85 miles fence in top condition; cross fenced into sufficient pasture for good summer operation. Easy access to good shipping point. On good county road. Priced to sell.

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EQUIPMENT MEN

(Continued from page 203)

Brewster Co. Names Johnson Ass't. Manager of Sales

J. D. JOHNSON

J. D. Johnson has been promoted to assistant manager of sales for The Brewster Co., Shreveport, manufacturers of drilling equipment, according to a recent announcement by Phil J. Parker, manager of sales. He has been with Brewster during the past 11 years, and until his recent promotion, he was sales representative in the Ohio area.

Sponberg Made Purchasing Agent by Tex-Tube Supply

Tex-Tube Supply Co. has appointed E. T. Sponberg purchasing agent. Sponberg comes to the company from the position of assistant purchasing agent for The National Supply Co. where he gained broad experience in industrial purchasing. Sponberg will be active in the purchase of tubular goods carried by Tex-Tube in all grades including stainless.

Goulds Pumps Holds Regional Sales Meeting in Tulsa

Distributors and factory representatives attending Goulds Pumps, Inc., Tulsa district sales conference, March 2-3 at Tulsa, were, front row: J. P. Lonberger, Tulsa district manager; Ed Genereux, Joplin Supply Co., Joplin, Mo.; Philip J. Olmstead, assistant chief engineer, Seneca Falls, N. Y.; C. L. Forshee, assistant sales manager, Seneca Falls; O. A. Forslund, president, Forslund Pump & Machinery Co., Kansas City; Ralph S. Beeson, salesman, Forslund Pump, Kansas City; H. J. McDonald, sales engineer; W. H. Plowman, sales engineer. Second row: R. L. Bratcher, manager Wichita branch, Forslund Pump; Louis Loeffler, president, Federal Supply Co., Oklahoma City; J. G. Johns, J. G. Johns Co., Abilene, Tex.; E. Gulick, salesman, Joplin Supply Co., Joplin, Mo.; Louis Laurel, Mine & Smelter Supply Co., El Paso, Tex.; G. B. Griffin, sales engineer; W. Fightmaster, salesman, Federal Supply Co., Oklahoma City; B. Fox, salesman, J. G. Johns Co., Abilene; R. L. Triplett, salesman, Forslund Pump, Wichita, and Baird Whetstone, salesman, Federal Supply Co., Oklahoma City.

Goulds Pumps, Inc., is conducting a series of 2-day regional engineering sales meetings to acquaint its branch office salesmen and local distributors with two of the company's new pumps —a single-stage, double suction centrifugal pump for general liquid handling, and a close-coupled unit designed especially for air-conditioning service.

The first two meetings were held at the company's main office in Seneca Falls, N. Y., February 9-10, and 16-17; the third meeting was held in Chicago, February 23-24, the fourth in Tulsa, March 2-3. Other meetings have been held in Houston, March 6-7, and Atlanta, March 16-17.

Working models of the two pumps were the central features of the meetings, which were conducted by Carl Forshee, engineering line sales manager, and Phillip Olmstead, assistant chief engineer.

Byron Jackson Elects Harcus As Director

R. T. HARCUS

E. S. Dulin, president of Byron Jackson Co., has announced the election of Robert T. Harcus to the board of directors. Harcus will fill the vacancy created by the resignation of C. S. Thomas, who was recently appointed Under Secretary of the Navy. Simultaneously, Harcus was appointed to the newly created office of the executive vice president.

Harcus has been associated with Byron Jackson since 1945 when he joined the company as export representative. In 1949 he was appointed executive vice president and general manager of International Cementers, Inc., which later became BJ Service, Inc., a wholly owned subsidiary of Byron Jackson Co. In 1951 Harcus became a vice president of the parent company and assistant to the president.

ESCO Appoints Allen to New Intermountain Branch

Electric Steel Foundry Co. of Portland, Ore., reports the opening of a new branch office in Salt Lake City. This new branch will cover the intermountain territory comprising Utah, Colorado, southeastern Idaho, and southwestern Wyoming, and will afford greatly improved service to ESCO customers and dealers in that region.

Garland T. Allen, who has been representing ESCO in the Portland area for about 11 years, is manager of sales based in the Salt Lake establishment. Allen is thoroughly familiar with

ESCO's diversified lines of products and equipment. The new branch will draw on the company's coast warehouses for stocks to supply the territory's requirements.

New Pipe Line Firm to Handle Shortstir Mixers

The recently organized Peddlers, Inc., pipe-line-equipment company of Houston, have added Shortstir side-entering mixers, manufactured by Sawyer-Jensen-Ross Co. of Tulsa, to its line of pipe-line equipment, according to J. L. Joplin, president of the new firm, and formerly division manager in Houston for Buda Engine & Equipment Co.

Associated with Joplin in the new company are E. L. Rolfs, founder and former president of Crutcher-Rolfs-Cummings, Inc., and J. D. Brance, past president of Brance-Krachy Co., Inc., of Houston.

Peddlers, in conjunction with Sumner Co., of Shreveport, will be exclusive representatives for the mixer in Mississippi, southern Arkansas, Louisiana, and Texas, except for the Texas Panhandle.

Expansion Move Made By Muldrow Aerial Surveys

An expansion and move of its main offices was announced recently by Muldrow Aerial Surveys Corp. Formerly of Midland, Tex., the company has moved its main office to Oklahoma City, according to M. Ellison Muldrow, president.

Muldrow stated that the firm now has available over a million square miles of controlled regional base maps for its clients.

Plans for further expansion are also contemplated, and the new Oklahoma City headquarters has over 30 employes, including cartographers, engineers, draftsmen, reproduction experts, and clerical help.

The firm, which was founded in 1936, originally mapped only the Permian basin of Texas but, according to Muldrow, the base maps now extend from the Rio Grande into Canada, and from the Mississippi to Idaho.

Muldrow Reproduction Co., an affiliate, will still maintain its quarters and plant in Midland, Tex.

LEGAL

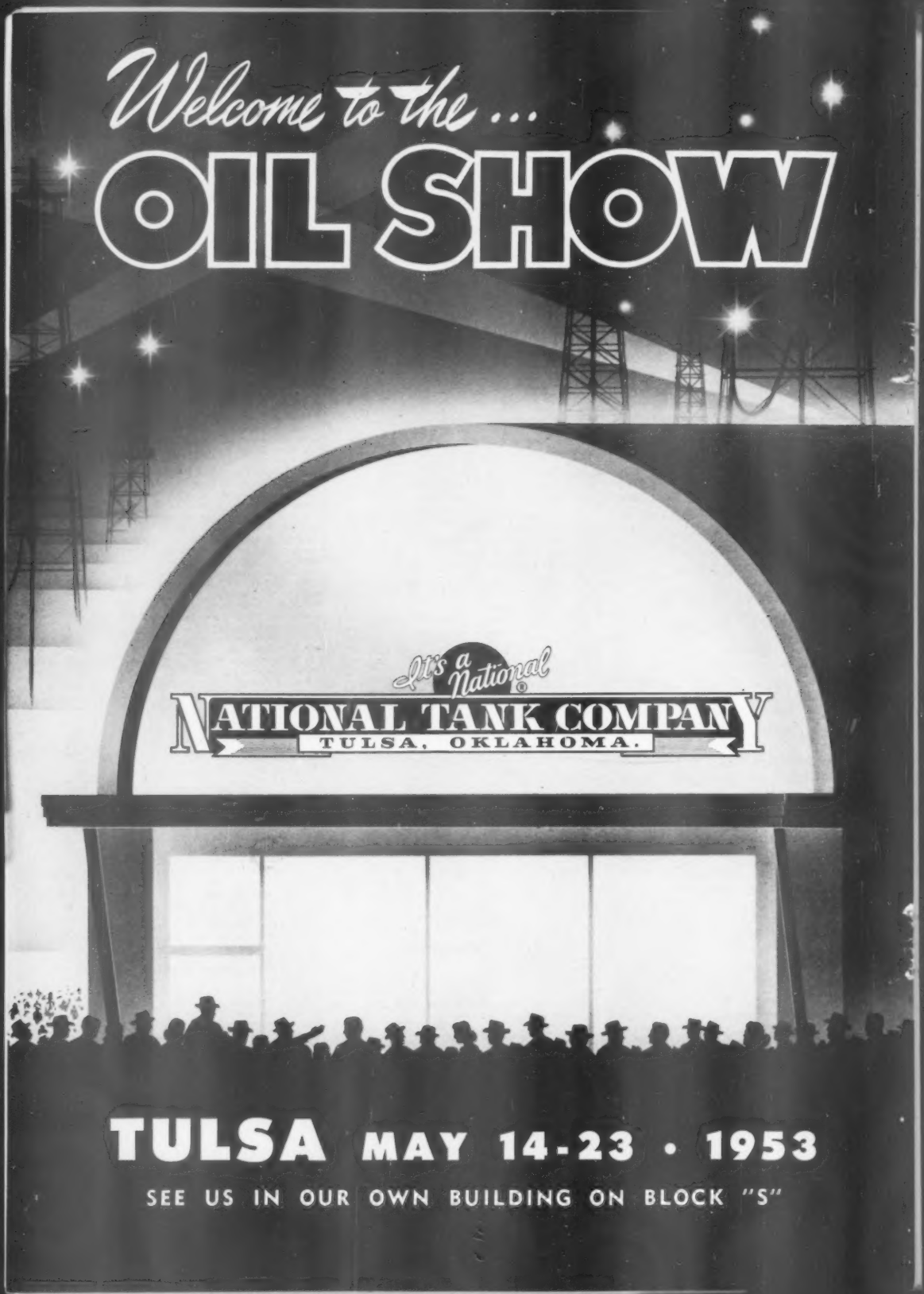
Sealed bids on Oil and Gas leases on 19,973.80 acres of Tribal and Allotted Indian lands on the Fort Peck Indian Reservation, Roosevelt County, Montana, will be opened at 2:00 P.M., April 3, 1953, in the office of the Superintendent, Fort Peck Indian Agency, Poplar, Montana. Specific information in connection with this sale of leases may be had by letter or wire to James D. Crawford, Superintendent, Fort Peck Indian Agency, or by phoning 2181, Poplar, Montana.

ADVERTISERS

Acme Oil Tool Company 224
Advertising Council, The 43
Aetna Ball and Roller Bearing Company 19
Air Reduction Magnolia Company 74
Allis-Chalmers Mfg. Co. 45
Allis-Chalmers Mfg. Co. (Tractor Division) 66
Allen Foundry & Machine Works 223
American Chain Division of American Chain & Cable 48
American Iron & Machine Works Co. Back Cover
American Manufacturing Co. of Texas 4
Appleton Electric Company 147
Bakelite Company
A Division of Union Carbide and Carbon Corporation 219
Baker Oil Tools, Inc. 47, 227
Banff Oil Ltd. 203
Bank of Montreal 188
Baroid Sales Division, National Lead Company 101, 102
Bell Rubber Company 210
Bethlehem Steel Co. 69
Bovaird Supply Co., The 20
Bowen Co., S. R. 131
Brooks Paper Co. 139
Brown Fintube Co., The 14
Butler Manufacturing Co. 15
Campbell Chain Company 206
Cannon Electric Company 168
Carter Company, Inc., S.C. 80
Caterpillar Tractor Co. 11
Century Geophysical Corporation 145
Chapman Valve Mfg. Co., The 34
Chemical & Geological Laboratories 151
Classified Advertising 243, 244, 245, 246
Cleaner Pipelines Co. 204
Cleveland Trencher Company, The 203
Continental Motors Corp. 37
Coppus Engineering Corp. 3
Core Laboratories, Inc. 92
Crose Manufacturing Co., Inc., M. J. 206
Dean Brothers Pumps, Inc. 186
Desco Service Co. 47
Detroit Diesel Engine Division, General Motors Corp. 28
DoAll Company, The 228
Dowell Incorporated 236, 237
Dresser Industries, Inc. 162, 163
Drilling & Service, Inc. 235
Duff-Norton Mfg. Co. 17
du Pont 29
Empire Trust Company 233
Fairbanks, Morse & Co. 186
First National Bank in Dallas 196
Fluid Packed Pump Company 199, 200
Fluor Corporation, Ltd., The 21
Fort Worth National Bank, The 128
Foster Company, L. B. 209
Franks Machine Co. 166
Gardner-Denver Company 33
Gar Wood Industries, Inc. 71
Gaso Pump & Burner Mfg. Co. 13
Geological Well Service Company 224
Geophysical Consultants, Inc. 172
Geophysical Service, Inc. 134
Geosels, Inc. 167
Goodrich Chemical Company, B. F. (Hycar) 73
Gott Mfg. Co., H. P. 164
Grancell, I. H. 221
Griscom-Russell Co., The 10
Guiberson Corporation 155
Halliburton Oil Well Cementing Co. Inside Front Cover, 9
Happy Company, The 52
Harnischfeger Corp. 30
Harrisburg Steel Corporation 46
Hawthorne, Inc., Herb J. 99
Hazard Wire Rope Division of American Chain & Cable Co., Inc. Inside Back Cover
Hilliard Corporation, The 186
Hughes Tool Co. Front Cover
Hyatt Bearings Division, General Motors Corp. 22
Independent Exploration Co. 94
Industrial X-Ray Engineers 164
Inferno Co., The 210, 212
International Petroleum Exposition 95
Iverson Supply Company 78
Jensen Brothers Mfg. Co. 164
Johnston & Jennings Company, The, Division of Pettibone Mulliken Corporation 47
Jones & Laughlin Steel Corporation Supply Division 12
Jones Company, the S. M. 24
Kelley Company, Ben F. 179
Kennametal, Inc. 31
Landis Machine Co., The 7
Lane-Wells Company 59
Link-Belt Speeder Corporation 16
Lisle, B. Orchard 212
Lone Star Cement Corporation 54
Lufkin Foundry & Machine Co. 40
Maloney-Crawford Tank & Mfg. Co. 202
Martin-Decker Corp. 232
Masoner's, Inc. 170
Mayes-Bevan Company 125
McCollum & Co., E. V. 167
McCord Corporation 208
McCullough Tool Company 213
McKissick Products Corporation 192
Mid-Continent Supply Company 150
Midwest Piping Company, Inc. 6
Minneapolis-Moline 194
Mission Mfg. Company 181, 182
Morse-Starrett Products Company 184
Muldrow Aerial Surveys Corp. 224
Murphy Diesel Company 38
Muskogee Iron Works, Inc. 2
Nash Engineering Co. 18
National Airoil Burner Co., The 209
National Bank of Tulsa 8
National Geophysical Company, Inc. 158
National Tank Company 240
Nordberg Mfg. Co. 41
North American Geophysical Company 96
Oil and Gas Journal, The 212, 233
Pacific Pumps, Inc. 162, 163
Parkersburg Rig & Reel Co. 39
Peerless Supply Co., Inc. 212
Penn Controls, Inc. 225
Perforating Guns Atlas Corporation 231
Petty Geophysical Company 98
Price Company, H. C. 207
Rand, W. W. 170
Reed Roller Bit Company 226
Republic Steel Corporation 27
Republic Supply Company 89
Rogers Geophysical Company 91
Rotary Engineering Company 172
Rust-Oleum Corporation 25
Schlumberger Well Surveying Corp. 127
Security Engineering Division Dresser Operations, Inc. 161
Seismic Explorations, Inc. 123
Seismograph Service Corp. 85
Shortes Drilling Company, V. M. 128
Sivalls Tanks, Inc. 183
Smith, Barney & Co. 234
Smith Oil Tool Co., H. C. 211
Southern Geophysical Company 86
Southern Mill & Mfg. Co. 160
Southwestern Industrial Electronics Co. 100
Sperry-Sun Well Surveying Co. 173
Spicer Mfg., Div. of Dana Corp. 26
Standard Oil Co. of California 32
Standco Brake Lining Co. 212
Steel Forgings, Inc. 204
Technical Oil Tool Corp., Ltd. 222
Tex-Tube Supply 229
Thompson Tool Co. 142
Tobin Aerial Surveys, Edgar 93
Tube Turns, Inc. 35, 36
Tulsa Paper Company 212
Union Carbide and Carbon Corporation, Bakelite Company 219
United States Rubber Company 49
U. S. Steel Corp. Subsidiaries 216
Universal Atlas Cement Co. 216
Vickers, Incorporated 23
Walker-Neer Manufacturing Company 84
Warner Lewis Company 44
Washington Iron Works 44
Web Wilson Oil Tools 170
Well Reconnaissance, Incorporated 87
Western Company 215
Western Geophysical Company of America 88
Williamson, Inc., T. D. 5
Willson Products, Inc. 42
Willys-Overland Motors, Inc. 97
Wilson Supply Company 130
Winter-Weiss Co. 137
Wood's Sons Co., T. B. 208
Youngstown Sheet and Tube Company 65

LEGAL

Sealed bids for oil and gas mining leases on 4,368.12 acres of trust lands on the Crow Indian Reservation, Big Horn County, State of Montana, will be received at the Office of the Superintendent, Crow Indian Agency, Crow Agency, Montana, up to 2:00 o'clock P. M., Mountain Standard Time, April 10, 1953. For further information, call or write L. C. Lippert, Superintendent, Crow Agency, Crow Agency, Montana.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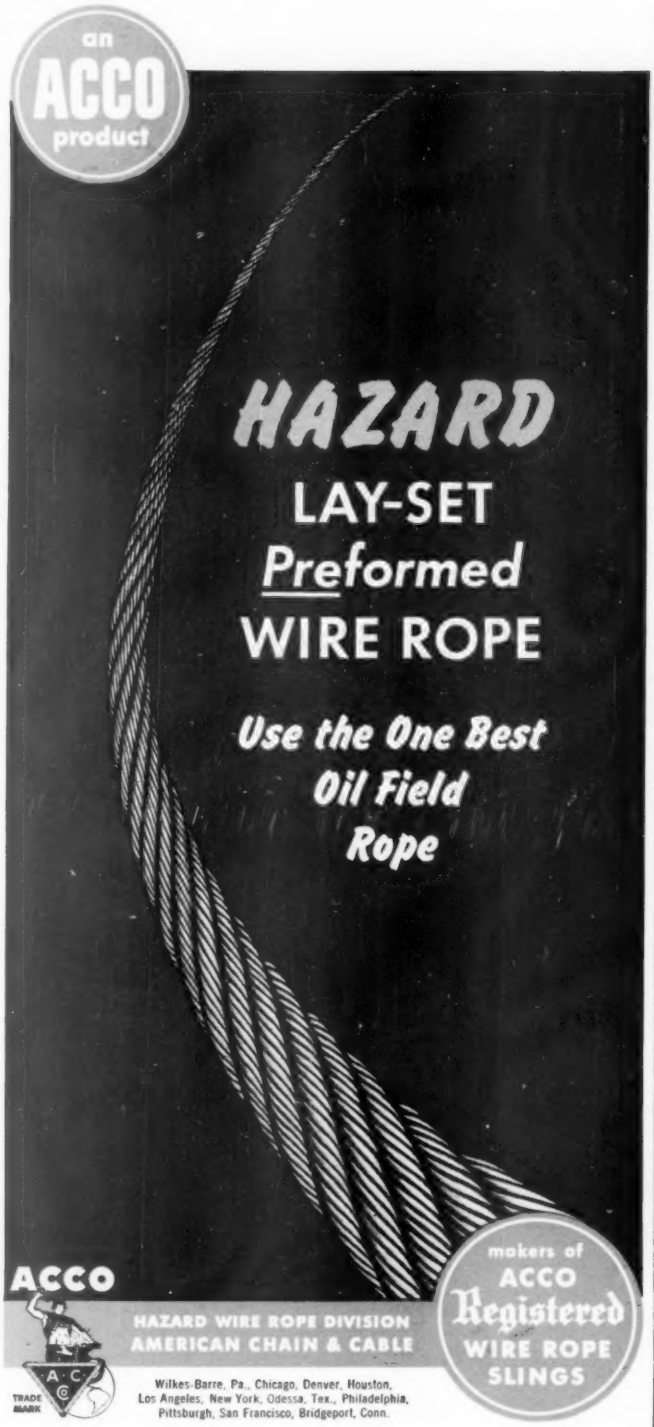

DRILLING

Seven Practical Rules Increase Service from Rotary Drilling Lines

The drilling line is one of the most costly expendable items in rotary drilling, so if by following certain recommended practices the driller can increase the life of his line, the cost will be reduced. Here in concise, boiled-down form are seven practical rules for buying and using rotary drilling lines:

1. **Buy only the best** type and grade wire rope. It is false economy to buy any but the best line to meet the severe service requirements of rotary drilling. The best line is 6x19 Seale, improved plow steel with wire core, and of course, preformed.

2. **Buy lines long enough** to allow for sufficient cuts at the drum end. Lengths should be based on practices in your local field. The longer the line, the more ton-miles per foot you'll get.

3. **Set up a uniform number of ton-miles** between cuts so you'll have a basis for evaluating the actual work done since last moving the line to change wear points. This will avoid the need for long cuts to remove worn line sections.

4. **Inspect your line at regular intervals.** Avoid unnecessary abuse and excessive wear. Inspect at least once each day, preferably once each tour.

5. **Use drum-type tie-down** so as not to distort or damage a part of the line which will later have to pass through the blocks. The drum-type reduces the time required for cutting the line.

6. **Keep daily ton-mile service records** at the rig. One of the simplest and easiest to use records which we have seen is available without charge through Hazard wire rope distributors. It is a three-cover book with replaceable record pad and provides a permanent record for home office analysis.

7. **Get the advice** of your local Hazard wire rope distributor or Hazard representative. He has had broad experience in selling and servicing rotary drilling lines and can give you information which will save you money. What he has learned in talking with drillers on the wide variety of rigs being used in old and new fields can be worth a great deal. He carries a stock of the popular sizes of drilling ropes and is ready to serve you at any time.

(Advertisement)

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